THE

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CONTENTS:

	PAGE
The Dawn of the Horseless Carriage	647
Electricity Meters	649
The Rouen Electric Tramways (*illustrated*)	650
The Survival of the Fittest (*illustrated*) (*concluded*)	653
Cable-Laying, Stuffed Birds, Beetles, and Men	655
A New Transmission Dynamometer (*illustrated*) (*concluded*) ...	656
The Manhattan Enclosed Arc Lamp	657
The Röntgen Rays	658
Cable Laying on the Amazon River (*illustrated*)...	659
Sullivan's Universal Galvanometer	660
Correspondence :—	
To Avoid Misunderstanding	661
Dynamos for Electrolytic Work	661
Gas Engines and Alternators	661
The Horseless Carriage Company	661
A Correction	661
Business Notices, &c....	661
Electric Lighting Notes	662
Electric Traction and Motive Power Notes	664
Telegraph and Telephone Notes	665
Contracts Open and Closed	665
Notes	666
City Notes	669
Traffic Receipts	670
Share List of Electrical Companies	671
The International Telegraph Conference of 1896	672
Proceedings of Societies :—	
The Institution of Electrical Engineers (*illustrated*) ...	674
Safety Trolley Wire Supports (*illustrated*)	677
The Exhibition of the Société Internationale des Electriciens...	677
New Patents	678
Abstracts of Published Specifications	678

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THE DAWN OF THE HORSELESS CARRIAGE.

TUESDAY last was a somewhat remarkable day in the history of the horseless carriage, for on that occasion prospectuses of the Great Horseless Carriage Company, Limited, and the London Electric Omnibus Company were issued to the public. Of the former, which is to be formed with a capital of £750,000, and includes among its many patents some electrical ones, we propose to say little, but the latter, which is seeking a capital of £250,000, is of more than passing interest to electrical circles. The horseless carriage has been most effectively boomed during the past few months, but the electrical car has not been very prominent. That fact caused no great surprise, however, for it was felt that electrically propelled vehicles were not sufficiently developed for them to immediately participate in the impending abolition of the horse. But that feeling may not have been altogether justified; it is certainly not shared by the promoters of the London Electric Omnibus Company, who bring forward what they term a "Sound Progressive Industrial British Enterprise." It is not every enterprise that could bear the weight of so many adjectives; but it will be useful to examine the prospectus in some detail. Before doing so, however, it will be well to mention that the London Electric Omnibus Company, Limited, is formed to introduce Mr. Radcliffe Ward's system of "Electric Street Traction." There is no man living who has wrought harder than Mr Ward towards making electric vehicles possible, and no man has had greater experience of this special form of traction.

The propulsion of street vehicles by stored electrical energy is an ideal system. Its convenience and its adaptability are far in excess of steam, gas, or oil motors; but, in other respects, it has hitherto proved to be much inferior. It would be gratifying therefore, not only to the promoters, but to the electrical industry generally, if the scheme now brought forward were to prove an unmitigated success.

There are, however, statements in the prospectus which seem to require further elucidation, or some modification, before one could feel quite satisfied with them. For instance, the third paragraph of the prospectus, which states that "the company has obtained the exclusive license for omnibuses and stage carriages generally, as well as cabs, in England," is not a model of lucidity. The non-technical mind might assume that the company would completely control all electrical omnibuses and carriages, whereas what is meant is that exclusive license has been obtained for Mr. Ward's system. That is not a very important point, however, but what is of greater moment is the use that is made of the fact that an electric omnibus from 1888 to the present time has run 5,000 miles. It is perfectly well known that Mr.

Ward's 'bus has done a good deal of work, and no doubt it has accomplished all that is claimed for it, but it is to be remembered that the 5,000 miles does not represent a period of continuous work. We are assuming, indeed it is so stated, that the 5,000 miles includes the total distance covered between the years 1888 and 1896. But such a performance, of course, would not approximate to actual work, for an ordinary road car would cover the same distance in less than three months. But the results of the prolonged performance of one 'bus, however, is made to form the basis of the cost of working a set of omnibuses, and unless extreme care has been taken it would be easy to fall into error as to what electrical omnibuses really would cost. For the sake of clearness it would be well to reproduce the estimate of economy put forward by the promoters:—

The estimate of economy effected is illustrated in the following tabular statement, showing the cost of working Mr. Ward's system as compared with that of the London General Omnibus Company, Limited, which represents, perhaps, the best that can be done by horse traction.

The following figures, extracted from the balance-sheet of the London General Omnibus Company, show the traction cost of 911 omnibuses for six months—10,693,359 miles—the actual number of miles run.

	£	s.	d.
Horse-keepers' wages and yard expenses ...	42,367	14	7
Horse stock, less sales and purchases... ...	48,826	10	3
MAINTENANCE.			
Food	119,016	0	6
Bedding, shoeing, and veterinary service	14,804	17	9
GENERAL.			
Harness, stable expenses, &c.	12,209	14	10
Total	£237,224	17	11

Dividing £237,224 17s. 11d. by 10,693,359 miles, equals 5·32 pence per omnibus per mile.

This is exclusive of drivers and conductors, office expenses, and general administration.

The following figures are based on the actual results obtained during the running of the electric omnibus 5,000 miles through the traffic of London streets:—

COST OF RUNNING 911 ELECTRIC OMNIBUSES FOR SIX MONTHS—13,264,160 MILES.

	£	s.	d.
Fuel, oil, and stores	24,633	8	9
Motive-power wages, engine-drivers, stokers, &c.	6,632	1	7
Maintenance of station plant, repairs, &c...	14,093	15	6
Maintenance of accumulators, motors, and gear	60,794	1	4
Station superintendence	17,286	18	6
Car sundries	11,827	4	2
Total	£135,267	9	10

Dividing £135,267 9s. 10d. by 13,264,160 miles (one of the advantages of the electric omnibus is that it runs a greater number of miles in the same working hours), equals 2·44 pence per omnibus per mile.

This is exclusive of drivers and conductors, office expenses, and general administration.

The published accounts of the London General Omnibus Company, from their balance-sheet of the 31st December, 1894, show an available profit for six months on the running of 911 omnibuses sufficient to pay 75 per cent. clear profit per 'bus per annum.

As we have already said, the comparison is based on what has been done by one 'bus running at less than 2 miles per day over a period of 8 years, against 911 road cars each doing 66 miles per day for six months, which would give each one a total of 12,000 miles for that period. The question arises as to whether maintenance of accumulators, motors, and gear is based on what was actually spent on the electric omnibus during its long period of easy work. Obviously wear and tear would be very different in a vehicle doing two miles a day and one accomplishing 66.

The estimate put forward seems to be in other respects unsatisfactory. If the cost per 'bus mile can be kept down to 2·44d. then there is little doubt that electric omnibuses will prove successful, but we want something more than 5,000 miles × 2·44d. = £50 extending over a period of eight years to prove it. We feel that the various items put down for fuel, motive power, wages, may also prove illusive. At any rate, before one would feel justified in accepting them, one would have liked some specific figures as to capital cost of engines, generators, motors, accumulators, &c., and the percentage allowed for depreciation, especially on the latter portion of the plant, but we have nothing but speculative lump sums, each covering several items, and in the face of previous accumulator experience on various tram lines, we have no proof that Mr. Ward's 'bus will not in the long run cost as much as the 5·32d. of the London General Omnibus Company.

The prospectus states that, without going into detail, it may be shortly explained that one of the features of the Ward system enables an electric car to start or run up hill without increase in the rate of discharge. Having regard to the fact that Mr. Ward is to receive £100,000, we think many more details are necessary than are provided.

No doubt Mr. Ward's method of starting or running a car up hill without increasing rate of discharge of the electric current may be a valuable one, though scarcely novel, for everyone knows that much more power is required in starting and running up hill than in traversing the level, and it is easy to double or treble the number of cells for such purpose, and although the rate of discharge may be kept the same, the E.M.F. will be doubled or trebled. A larger number of cells must be employed than is the case where the rate of discharge is varied, with probably dead resistances and variable gear.

But it is not a mechanical means of regulating cells that is most wanted in an electric omnibus. The primary need is an accumulator. Probably the London Electric Omnibus Company has secured one that may be proof against all the deleterious effects of road traction, but we trust they have had a lengthened experience of it. The best authorities have recently shown very conclusively that the essential features are durability, mechanical strength, and high discharge rates; the prospectus does not tell us whether these qualifications have been secured, so it would probably have been a wiser course to estimate running expenses on cells already in the market. There are other statements in the prospectus that appear to be over sanguine; we can only hope they may be realised.

Having pointed out some of the defects in the estimates and views of the promoters, it is only fair to say that in other respects a good case is made out for the electric omnibus. It is undoubtedly superior to the horse-drawn car, and if it costs no more, then it unquestionably ought to be adopted, and no doubt, if a line of electrical omnibuses were put on the streets to-morrow, they would instantly take a high position in popular estimation.

We have already spoken of Mr. Ward's great and unique experience in this branch of electrical engineering. We wish

him personally the reward his years of untiring efforts have so richly deserved; but we doubt the soundness of the estimates in the prospectus, and we have therefore, much as we wish for the general advent of electric traction, and for Mr. Ward's pioneer success, deemed it a duty we owe to the profession, to the public, and to ourselves, to draw attention to a number of points which, to us, seem based on very shaky foundations.

ELECTRICITY METERS.

The position of affairs as regards electricity meters cannot be regarded as at all satisfactory; doubtless there are a large number in use, and there are inventors and manufacturers who advertise that theirs is "the only reliable one in the market." The value of such statements is, however, pretty well understood. The facts are really, that one has to put up with the best that can be obtained, and that best is not by any means all that could be desired. The best mechanicians have tried their hand at the problem, and have attained a certain measure of success after the expenditure of much time and money; but there is still a very great deal wanting. We have more than once been asked to recommend a meter, or meters, which would answer certain reasonable requirements, the meters which have hitherto been tried either requiring too much current to start them, or consuming too much current in the shunt coil, or will not work properly if there are motors in circuit, &c. This is especially the case when alternating currents have to be dealt with, the meters in this case showing a 10 to 50 per cent. error. Very few inventors have tackled the subject of alternate current meters; Lord Kelvin has done so, but his meter is not mechanically perfect. Aron's meter is nearly correct on all inductive loads, but mechanically leaves much to be desired. Periodic integrating meters have not proved a success, nor have clock meters, so that motor meters alone remain for us, and they are not perfect. We hear of meters about to be brought out, or just brought out, which are to meet all reasonable requirements; but our faith in such statements has been so often severely shaken, that we hesitate to accept them, and prefer to wait patiently and in hope whilst the mighty "time" test goes on and proves the value of what is said. We believe there is money in the matter, but money will have to be very freely spent before success is obtained.

Boilers for Electric Light Stations.

Our contemporary, the *Engineer*, is nothing if not ponderous. It does not relish the fact that we chose to comment on its recent article under the above title, and now sets itself to enlighten our ignorance and that of other electrical journals, under the plea that our comments of necessity were written by someone who had no practical experience of the Lancashire boiler, and that we, therefore, do not know what it can do or cannot do. We fancy our writer has a good deal more practical experience of Lancashire boilers than anyone in Norfolk Street, having owned them, worked them, and made them from the time they first fairly displaced the types which went before them. The *Engineer* is just beginning to find out what we have so long advocated, that a boiler requires considerable water capacity to make it a steady steamer, and we have never been upholders of an indiscriminate employment of water tube boilers, for, we believe, that they have been put into places entirely without consideration. One engineer, who has been responsible for the use of many of them, publicly confessed that he saw one through a plate glass window—presumably in a showroom, and exclaimed, "That's the boiler for my money!" As a matter of fact, the bulk of the published discussions on boilers which have appeared during the past few years, display a lamentable lack of practical acquaintance with steam raising, and much as we dislike the ponderous egoism of the *Engineer* and its affectation of superior knowledge, we realise that perhaps these are merely the editorial frillings put round an otherwise sound and plain garment. To speak of quick steaming is a common habit with water tube enthusiasts. They mean that they can soon get up steam with them and that they will soon answer to a pushed fire. But there is altogether too much hand to mouth work where boilers have small water capacity, and the labour which devolves on firemen is very severe. But when did the *Engineer* become alive to this? We fancy that its back numbers would reveal that the floor space of Lancashire boilers was excessive, and that it can only have been quite a recent discovery on its part that even a large Lancashire boiler will do 600 H.P.

Writing to the *Engineer*, Mr. Gross, of John Brown & Co., Limited, puts in a plea for the marine boiler as superior to any other. He states that they have taken out 50 of their many Lancashire boilers and replaced them with Scotch boilers with Serve tubes and Ellis & Eaves draught. Their power totals up to a total of 150,000 pounds of evaporation per hour. The space occupied is stated as less than that required for Lancashire boilers, and the efficiency is stated to be 72½ to 75 per cent., even at rates of 45 pounds of coal burned per square foot on grates 5 feet 8 inches long. Thus a boiler 10 feet 6 inches diameter and the same in length, with its fan and engine, occupies a space of 19 feet by 12 feet, and will give 12,000 pounds of steam per hour, or even 15,000 with special coal. There is no brickwork and everything is accessible. We do not see that these boilers are any more efficient than the modern Lancashire boiler, especially when these are of large diameter, and there is really no reason why the Lancashire boiler should not be as large in diameter as the marine type. Indeed, all shell boilers are equally placed in this respect. But the marine boiler has an objection from which the Lancashire boiler is free, as any one can tell who has had experience of the marine boiler in a cellar. The temperature in such a case is far more intolerable than in the case of Lancashire boilers with protecting casing of brick. A case in point was—perhaps still is—the underground station at Whitehall Court beneath the street surface. The heat of this station was intolerable and there was a marine boiler. Anyone desirous of using marine boilers should take special precautions in their covering. Undoubtedly the marine boiler with its large diameter is very efficient per square foot of ground covered, but it is scarcely a fair comparison to take out boilers of 7 feet diameter, the probable size of those removed by Mr. Gross, and put in 10 feet boilers and claim a greater efficiency per unit of ground plan. Necessarily the higher boiler must have the advantage, but, as we have already said, there is no limit to the shell diameter of the Lancashire boiler that does not apply equally to the marine type. We believe Messrs. Brown are makers of Serve tubes. May not this fact have an influence upon their choice of boilers? Naturally they will put in such boilers as can be best fitted with tubes. But where people are fond of using tubes, why not put them in Cornish or Lancashire boilers? We have ourselves used such boilers 20 years ago.

THE ROUEN ELECTRIC TRAMWAYS.

As most of our readers will be aware, from the various descriptions and illustrated articles already published in some of the technical papers, the public service of electric cars on the Rouen tramway system has been in operation for some time past—the formal opening of all the lines having taken place on March 22nd last, whilst certain sections had been at work for six weeks previously.

In view of the fact above mentioned, that detailed accounts in the usual descriptive style were lately to be found in the pages of our contemporaries, we do not propose to deal with the matter quite in the same way, but shall rather discuss the leading features and characteristics of the work carried out at Rouen from a critical, or, at any rate, from a comparative standpoint. This will be the more interesting to our readers, as the absence, at present, in France of what corresponds to the authority of our English Board of Trade renders tramway work, in certain respects, somewhat different in that country, and might even cause some to say that there are matters which are *not*, perhaps, arranged better abroad.

The subject matter of any such tramway system as that under notice falls naturally under four heads, viz., *track*, *power house*, *circuits* (out and home), and *rolling stock*. Taking these in order, the track on the Rouen lines of course offers features of interest to electrical engineers, principally in so far as it is well adapted or not to the heavy stresses which the rails undergo with the use of electric traction. Probably the tracks on no two English and French tramways would be found identical, since every tramway manager or engineer has his own particular views as to the best type of permanent way for given conditions. The grooved girder rails employed on the Rouen lines do not appear to differ materially from such as good practice would recommend anywhere, and such as have been adopted on English lines. Weighing nearly 90 lbs. to the yard, and laid, generally speaking, in 10 metre (33 feet) lengths, they compare favourably with the Dublin and Bristol track, though the section does not strike one as being so good in design, the centre line of pressure being very asymmetrical with regard to the web. Moreover, the base of the rail (4 inches) appears hardly broad enough for the height (7 inches), in view of the fact that no concrete or other specially prepared foundations are employed. The latter fact is worth noting. Both at Dublin and Bristol a substantial concrete foundation is provided for the rails, with good reason, too, for the stiffer and harder such foundation is, the smoother will the cars run, always supposing that plenty of good springs intervene between the track and the body. This plan of making a solid hard road bed is not thought good practice by many, but it is obviously cheaper and better to mount car bodies on very elastic springs, capable of easy renewal, than to be continually tinkering away with road repairs on an elastic track.

The subsoil at Rouen appears to consist of very hard sand and gravel, so that the rails bed themselves down, and make what soon forms a foundation of natural concrete. Moreover, as most, if not all, the streets are paved with setts, whilst all the lines are in any case paved for 18 inches on each side, there does not arise the same difference in level (owing to difference in wear) between rails and road surface as would be the case with macadam or wood. The type of track adopted may, therefore, be thoroughly justified by local conditions.

The rail joints—which, after all, are the most important feature in any track—appear to be tolerably solid and well made; fish plates, 18 inches long, slightly dished on the inside, and secured by four bolts and nuts, provide good bearing surface both top and bottom, being wedged in, as it were, by the bolts between the upper and lower girder plates on each side of the rail web. It seems a difficult matter in tramway work to use fishplates that bend under the rail, and so maintain the rails at the same constant level, apart from the resistance of fishplate bolts to shearing or twisting stress. This is done very often on main line railways; but there, of course, the joints are usually suspended, not continuous and solid. The question of a perfect rail joint has great importance, not only for the track layer or civil engineer, but also for the electrical engineer, in view of the heavier cars and direct attachment of the motive gear to the trucks; and without entering into such matters as cast or welded joints, it ought to receive more attention than has hitherto been given to it in this country, in regard, that is, to its mechanical aspects alone, apart from the use of the rails as a return for the current.

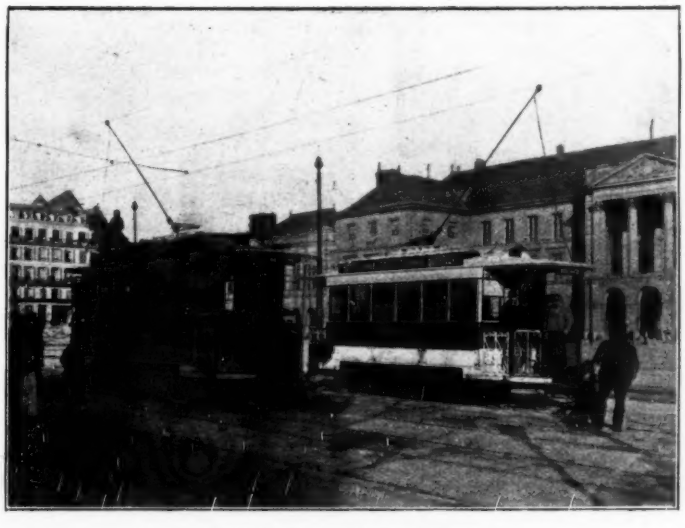
On the Pont Corneille, Rouen.

In the second place may be noticed the power house and generating plant. The site chosen appears to be nearly central, not only as regards the disposition of lines, but also the weight of traffic, as far as outsiders may judge. It seems a pity, seeing that condensing engines are employed, that a site on the river bank (which is only a few hundred yards distant) was not available, and we are not at all sure but that the engineers of five years hence would have proposed, for such a system as that at Rouen, a high pressure generating station on waste ground down the river, with a couple of transforming stations on the network itself.

The station buildings—as might be expected in France, where the useful and ornamental are always united as far as possible—present a very fine, if not elaborate appearance; the engine and dynamo room especially is most handsome and massive, being nearly 40 feet high, and generally proportioned, almost like a small cathedral. The subsoil in this locality being extremely wet, little better, indeed, than a marsh, great care has been necessary in the foundations, for which a large number of piles were sunk, with heavy timbers and layers of concrete on the top. In dealing with the entire subject of foundations in bad ground, one is reminded irresistibly of the trouble that George Stephenson had with the Liverpool and Manchester Railway, over Chat Moss, and so far as engine vibration is concerned, it is probable that more would be felt, and more damage done under ordinary conditions, from the slow pumping up and down of a heavy mass of concrete or other foundation for belt-driving engines, than from a fast running direct coupled set mounted on a floating framework. As for the buildings, in such a case, many

engineers would save money and trouble at the same time by designing them of a construction as light as possible, so that the foundations need not be at all elaborate. Of course, if good appearance is wanted, and the station is intended to be more or less of a show place, expense both below and above ground is fully justified; but in building upon a marsh, one is tempted to use a good deal of corrugated iron, or its equivalent. At Rouen the difficulty is overcome by making what is, in effect, a solid foundation or substratum of concrete over the whole area occupied by the buildings; but, of course, at a heavy cost.

The generating plant consists of belt-driven units; the engines are of the horizontal single cylinder condensing type, and drive the dynamos by belts from the fly-wheels. The reasons for adopting one form of engine rather than another are so extremely numerous and complex, that one finds it difficult to say whether the course adopted at Rouen is commendable or not. Fuel is by no means cheap, Welsh coal costing at least 20s. per ton delivered in large quantities. On the other hand, there is no conveniently large and economical water supply available, and hence the use of condensers implies, also, the use of a water cooling arrangement in order to save the cost of continually drawing large supplies from the town mains for condensing as well as boiler feed. The chief point that would, in our opinion, have helped to decide the matter, is that of space in the power house. This is decidedly limited, having in view the probability of extensions being required; and hence it would seem perhaps better to have used direct coupled sets. As it is, the engine cylinders stand next to the dynamos, and the engines run backwards, in order to have the tight half of belt at the bottom. At the time of our visit, this meant running against the brushes, and it speaks well for the Thomson-Houston generators to say that they did it without the least trouble. Indeed, these machines appear capable of almost anything; a short-circuit, or tremendous momentary over-load, makes the belt squeal for a few seconds, and that is all. We have no doubt that generators adapted for direct driving would acquit themselves equally well under proper conditions; and seeing that Rouen already has 45 motor cars running, with others about to follow, there should prove no such enormous load variations as would render direct coupled machines unadvisable by reason of wastefulness or danger from sudden changes.



Place Hotel de Ville, Rouen.

A noticeable feature in the engine room is—to use an Irishism—the "absence" of testing panels, &c., from the switchboard. There being no Board of Trade regulations with regard to maximum permissible leakage current, the only impulse to carrying out periodic and careful tests upon the network is the highly commercial one of preventing undue waste in case defects arise either in the feeders, trolley wire or return circuit. It is evidently considered in France that this game of testing is not worth the candle that it requires in the shape of special wires and instruments; but doubtless, as matters progress, it will be found that by spending 4d. in this way, 6d. may be saved on general expenses. There are few English engineers who would grudge the small extra outlay required by the Board of Trade rules, inasmuch as their net effect is to ensure that the tramway manager must have always at hand information that has some value to the Board of Trade and to the local inhabitants and authorities, but which has still more value to the tramway management itself, if only to reduce its coal bill.

It is, by the way, interesting to note, that much as the telephone interests are disliked in this country for the high-handed disposition which they have shown for a long time past, yet the French have still less cause, as tramway shareholders, to bless the department of their State which rules the telephone world. In England, the onus of doubling telephone circuits to avoid inductive effects from tramway working is thrown upon the telephone company; in France, on the other hand, the State takes upon itself to carry out this change after due circumlocution, but demands from electric tramway companies, such as those at Havre and Rouen, substantial "damages" for the extra cost involved, equal, perhaps, to one-third or one-half of the total amount; and there is no getting any authority to put up poles and wires until the question is settled by payment *pro tem.*

This brings us to the third section of our subject, viz., the circuits at Rouen, from power house to motor cars and back, and it is here that the chief differences may be found between English and French practice. Dealing first with the feeders, it is to be noted that the total length of such only amounts to 6 kilometres on a length of track equal to nearly 40 kilometres. Of course, at present, we have no tramway system in England that can in any way be called a network; the Bristol and Dublin lines are straight lengths, and the South Staffordshire but little more. To judge from the work already done, however, it may safely be asserted that the ratio between length of feeder and length of track will, in this country, be much higher than 1 to 6½. There is no need at this point to drag in Kelvin's law as to the economical use of copper, or any modern modification of that principle; the chief difficulty is to assign proper values to all the conditions that enter into play, not the least of these being reliability of working, or the maintenance of traffic in spite of obstacles and accidents. At Rouen the comparatively short lengths of feeders installed are, to some extent, counterbalanced by the use of two trolley wires throughout the entire system, whether the track be single or double. This device serves very materially to keep down loss of voltage at the extreme ends of the network, and so far, therefore, avoids the necessity for feeders; but then an extra trolley wire is not the equivalent for safety and reliability in continuous working of an underground feeder cable. It is much more liable to fracture or interruption from leakage, and in such an event the line becomes absolutely feederless.

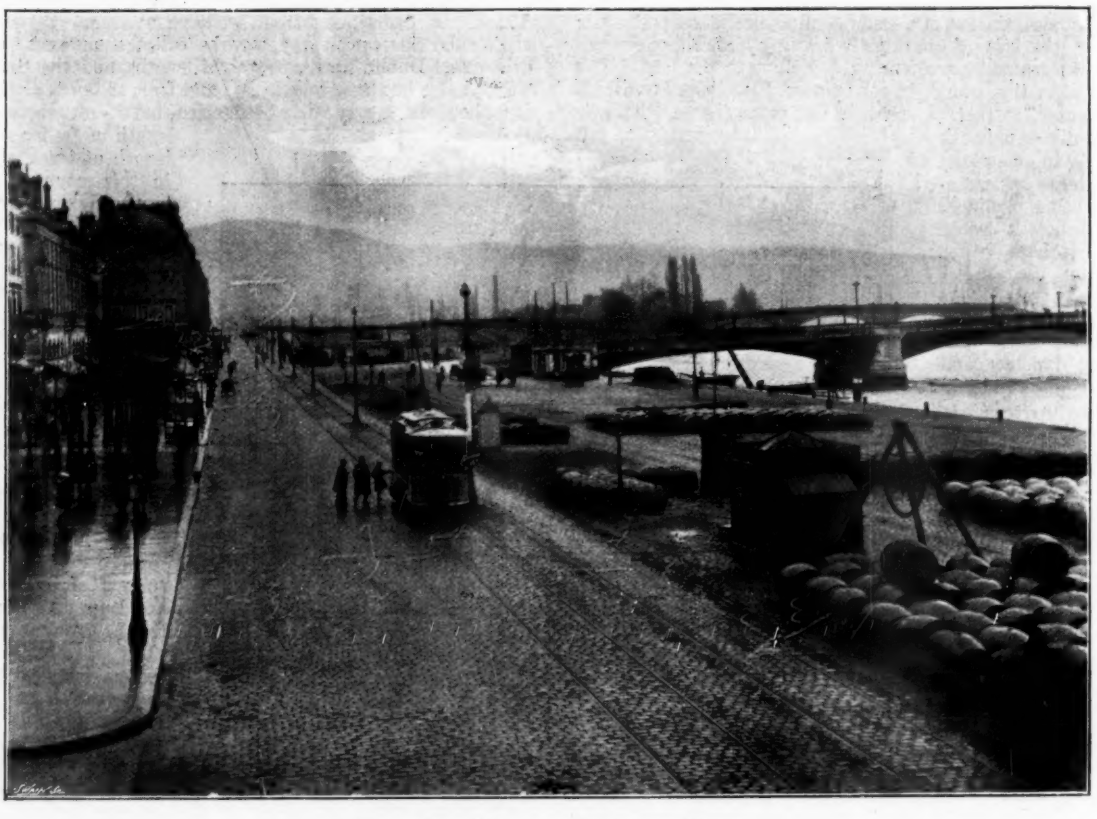
So far as we can ascertain, the overhead network at Rouen forms practically one complete whole, the feeders all being simply connected up to the trolley wires through switches. There appears to be no sectioning up whatever of the trolley wires themselves for the different lines, and although it is easy to switch off the feeders on the line at feeding points, no cutting off one section of overhead wire from another can be effected. The consequent difficulties in testing for faults or defects in the overhead work may therefore be readily imagined. The use of section insulators at each half mile or so would have overcome the trouble that will probably ensue from the conditions at present appearing to rule.

It is questionable whether, in regard to the overhead work, any large network of lines in this country would be equipped to such an extent with span wires across the streets as is the case at Rouen, in common with many other Continental towns. There is a strong and reasonable prejudice against

the use of opposite poles and span wires, unless the streets are either too wide for single bracket poles placed on the footpaths, as on the South Staffordshire line, or too narrow for the double track with double bracket centre poles, similar to those employed at Bristol. Of course, the decision of such a matter rests largely with the local authorities: but there seems no good reason for erecting span wires when single bracket poles on the side walk will serve, given a trolley arm with long swivel or great radius of swing (at least 90°), like that devised by Dickinson. Span work is doubtless somewhat stronger in daily operation, and conduces to better running with less wear and tear; but the saving in this respect is hardly worth the loss of popularity which the line might otherwise gain. So far as Rouen is concerned, it must be remembered that many of the streets are extremely old and narrow, so that the use of a "Dickinson" trolley arm would be the only chance of avoiding span wires. Presumably there must have been difficulties in the way of its adoption.

The return circuit at Rouen may be said to depend entirely upon the rails, for the small bare tinned copper wire run alongside the outgoing feeder cables can hardly make much appreciable difference. With rails of the weight employed, the sectional area is ample for any currents likely to be required, since each rail is practically the equivalent in section of, at least, a square inch of copper. Everything therefore depends upon the bonds at the rail joints, and in this respect the use of two No. 00 Chicago bonds at each joint is a feature to be highly commended in the Rouen tramways. In regard to cross-bonding—a subject upon which doctors greatly differ, especially when a supplementary return wire is used—the plan followed at Rouen appears quite sensible and sufficient. The nearest opposite joints (as the rails break joint, the bonds on one line of rails are not opposite those on the other, but half a rail length apart) are connected diagonally across the track by a bare tinned copper wire twisted round and soldered to the bonds at each end: and this is done at frequent intervals, about every fourth or fifth joint. On double track, cross bonds are put in similarly about every ninth joint, from one track to the other. The object in cross connecting the rails like this is, of course, to prevent sparking at the wheels due to large unequal differences of potential between the different rails when defects arise in the joint bonding. It has for some time, by the way—speaking of the flashes so often seen at the car wheels—been more or less of a puzzle to us why some better means should not be employed for returning the current to the rails. A cheap, easily renewable steel wire track brush, would not only serve to keep the rails clean, but might also act as a rubbing contact on the negative side of the motors that would prevent much deterioration of rail and wheel tyre surfaces.

From an electrical standpoint there is not very much to notice one way or the other in the Rouen rolling stock, which constitute the subject matter of our fourth and last section. The equipment generally is of the high class type developed through long experience by the Thomson-Houston interests, and no better need be desired. The controllers are of the improved K_2 form, that is, have nine contact points: with the first five of these the motors are in series, and in parallel with the last four. The arrangement at each step is somewhat as follows:—



View along the Quai de la Bourse, Rouen.

1. Motor fields and armatures in series: three resistance coils in.
2. " " " " two " "
3. " " " " one " "
4. " " " " all resistance out.
5. " " " " " " and fields shunted.
6. Motors in parallel: three resistances in.
7. " " two " "
8. " " all resistance out.
9. " " " " and fields shunted.

With regard to the installation generally, one is obliged to admire the energy and wisdom displayed in equipping the entire system at once, instead of following the usual half-hearted English plan of doing one section of line first in order to see "what it looks like, and how much it costs." Although there are many points to criticise in the Rouen tramway system as now equipped, and although in some respects its features are not up to date, but might have passed for good practice five or six years ago, yet it is—all things considered—well worth study by those engineers or authorities who may have to deal with similar enterprises in this country; and we are quite sure that visitors to the town will hear nothing but good spoken of the service, new as it is.

THE SURVIVAL OF THE FITTEST.

By PHILIP DAWSON.

(*Concluded from page* 624.)

ALL that we find to be proved by 10 years American practice has been fully supported by European results. The deputations from Glasgow and Belfast which have just returned from visiting the most important Continental tramway centres, are unanimous in the conclusion that after considering all the various methods of mechanical traction, such as steam, hot water, compressed air, ammonia, petroleum, gas, and accumulators, the only practical and feasible method is that of the overhead trolley. To quote from the able report of Messrs. Crawford and Young, of Glasgow, to their Corporation :—

"In observing the operating of the electric overhead system what strikes one most is the elasticity and flexibility of the service as compared with the rigidity of the cable service. In the busy central streets of Glasgow the speed of the present horse cars can scarcely be exceeded with safety, and one of the great attractions of the electric car is that it can put on speed whenever and wherever it is desired. This is what is wanted. As to control, there can be no doubt that the motor car is under perfect control of the driver, and can be pulled up even quicker than the horse car . . . .

"While, as we have said, we found *no one on the Continent favourable to the cable*, conversion to electric traction is going on everywhere. The lists appended to this report speak volumes for electric traction. They prove what we ourselves observed, viz., that quite a revolution is taking place in tramway traction on the Continent, and that electric traction is the universal favourite."

. . . . . .

"*The one great and practically the only serious objection* urged against the overhead wires is the objection to their appearance. This is the only reason why the system has not been adopted throughout in such cities as Budapest, the objection being to make a change in the general aspect of their much-loved city. We started our investigations more or less *in sympathy with this objection*, but we are bound to say that what we have now seen has *quite removed* from our minds *any objection to the overhead wires*. Where the system is carried out in the most approved manner, we found that the wires give only the very slightest offence to the eye, and that a few hours' familiarity removed the objections entirely."

The Lord Mayor of Belfast, Mr. W. J. Pirrie, in his report says :—

"Having regard, therefore, to the fact that *all practical objections to the overhead system have been surmounted*, and that any exceptions thereto from an æsthetical point of view have been reduced to an almost infinitesimal quantity in the best examples of the overhead system, the deputation feel perfectly confident that they are doing the right thing in recommending that system."

There is another consideration which has to be borne in mind, and which is very important from a financial standpoint, viz.: that wherever electric lines are built in the outskirts of towns, the value of landed property increases very greatly, and this point has not remained unnoticed by the Belfast deputation, who say in their report :—

"The deputation could not fail to observe in the various cities they visited that along what may be termed the suburban electrical tramway routes there is in nearly every case a rapid development of residential and other property, and a consequent enhancement of the value of the adjacent lands.

"They also remarked the facility with which trailer cars are attached to the motor cars to accommodate additional passengers when required, but more than one such car should not be permitted to be so attached.

"The deputation were continually struck with the fact that electrical traction can be worked by comparatively unskilled labour, with the greatest precision and delicacy of movement, and under the most perfect control. The deputation were satisfied of this by practical demonstrations, and the facility with which steep gradients can be mounted and descended. In Havre and Brussels they were driven at great speed, and, whilst doing so, the cars were quickly stopped and even reversed, without inconvenience.

"Their strong impression is that the travelling public are perfectly satisfied, and even delighted with this mode of transit. This is evidenced in a marked manner by the quickness of the service and the manner in which the cars are filled."

Well erected trolley lines are not eyesores, and the accompanying views from snap shots taken by the writer at Zurich, Geneva, Milan, and Rome, go a long way towards proving this assertion.

In the tables herewith, the working expenses of a few of the principal Continental electric lines will be given. Great interest attaches to these figures as they have been worked out from the official reports of the various tramway companies, who in no case have any particular interest in the adoption of any specified system of mechanical traction, but whose sole advantage lies in the adoption of that means which will assure the largest interest on the capital expended.

ZURICH TRAMWAYS.

Table XV. gives the working expenses of the Hanover tramways for the year 1895. This company when worked by horses scarcely paid a dividend of 1½ per cent. whereas last year, after having adopted electrical traction on some of its lines, it paid over 4 per cent. It is now engaged in equipping its remaining lines on the overhead system. It is true that in the centre of the town the local authorities will not yet allow an overhead wire—why, it is difficult to conceive—and in consequence of this the cars which enter the city each carry a battery of 200 3-plate Tudor accumulators, which are charged from the overhead trolley wire in parallel with the motors when the cars are running on the trolley system, and which are used to propel the cars when they leave the trolley wire and enter the centre of the city. The weight of the accumulators required for this service is nearly 2½ tons per car. As regards the question of maintenance and depreciation of the batteries, no figures are as yet obtainable, their manufacturers, the Hagen Company, having guaranteed their maintenance for a certain number of years at a fixed charge.

A similar system is also running on one or two short lines at Dresden. At the present moment there are in Hanover 13½ miles equipped on the electric overhead system, and 26⅔ miles still run by horses; the latter lines are, however, being transformed into trolley lines. The present capital of the company is composed of £225,000 ordinary shares, £125,000 preference shares, and £16,750 debentures. The capital has just been increased by £75,000. The number of electrical car miles run last year was 695,578.

Table XVI. gives the data relative to the Hamburg tram-

ways, all of which probably by the end of this year will be on the trolley system. This company paid last year a dividend of 5 per cent. Out of the total 29 million passengers carried on the whole system, over 7 million were carried by electric cars, and whereas a perceptible decrease has taken place both in the passengers carried and receipts on the horse line, the contrary has been found to be the case on the electric lines where the number of passengers carried has increased 32 per cent. since the introduction of the electric system, and the electric car receipts have increased 34·9 per cent. The company employs 2,177 persons. The concession has 27 years more to run. The current for running the overhead line is taken from the electric light works which belong to another company, to which the in its turn guarantees to buy at least 2½ million Board of Trade units per annum. The rate of charge being 1·56 pence per unit. Should 2½ millions be exceeded the price falls to 1·5 pence per unit. The Corporation pay the Tramway Company 20 per cent. of the cost of the current consumed, this being the amount paid by the Lighting Company to the Corporation for their concession—which reduces the actual cost per unit to the Tramway Company to 1·25 pence.

Table XVII. gives the working expenses of one of the electric lines now running in the city of Zurich and which has been working for over two years, giving the greatest satisfaction.

Table XVIII. is interesting as giving the operating expenses of steam, horse, and electric lines run by the same company, and the accounts of which have been kept on the

TABLE XV.—GIVING WORKING EXPENSES IN PENCE PER CAR MILE FOR HANOVER, 1895.

Management		·119
Wages and salaries and office expenses		·048
Train men		·684
		·851
Maintenance of uniform		·038
New uniforms		·058
Tickets		·042
		·138
TRANSPORTATION.		
Motor men		·641
Stokers		·156
Fuel		·382
Oil, grease and waste		·111
		1·290
Cleaning and Maintenance of trucks and trolleys		·783
Maintenance of trolley line		·060
Maintenance of power house		·119
Maintenance of car		·121
Car cleaning		·038
Car lubrication		·006
Maintenance of track		·077
Cleaning snow and ice		·269
Maintenance of buildings		·031
Lighting and heating cars		·033
Maintenance of tools		·015
Accidents		·025
		1·577
Insurance		·013
Rent		·414
Maintenance of electric lighting		·006
Sick fund		·079
Taxes		·192
Various		·037
		·742
Grand total		4·598 pence.

Number of employees, 645.

TABLE XVI.—WORKING EXPENSES IN PENCE PER CAR MILE OF THE HAMBURG ELECTRIC RAILWAYS AND TRAMWAYS.

Receipts	£170,248 10s.
Total passengers carried	29,164,237
Receipts per car mile, 1894 and 1895	8·248d.
Ratio of expenses to receipts	48 per cent.

1895, *Cost per Car Mile.*

Wages of conductors, motormen, inspectors, &c.	1·327
Current per car mile	·881
Repairs to motors, trucks and axles, and cleaning	·315
Lubricants and oils	·022
Inspection and supervision	·025
Maintenance of overhead line	·058
Renovation fund	·192
Sinking fund	·403
Interest on capital stock	·269
Amount paid to contractors for guarantee	·192
Amortisation of electrical equipment	·288
	3·972
Increase in receipts over previous year when lines were worked by horses	34 per cent.
Rolling stock (motor cars)	360
Closed trail cars	417
Open trail cars	25
Length of single track in miles	103
Passengers carried by electric cars	7,108,973

monopoly of furnishing electricity both for lighting and power has been granted by the Corporation. Should this Lighting Company, through any fault of its own, stop the Tramway Company from running cars it is bound to pay ninepence to the Tramway Company for each car mile which the latter has been unable to run. The tramway company

TABLE XVII.—WORKING EXPENSES OF ZURICH TRAMWAYS 1894 IN PENCE PER CAR MILE.

	Pence per car mile.
Management—salaries	·325
Materials	·054
Maintenance of track, wages and supplies	·263
Conductors and inspectors	·995
Materials, lighting, &c.	·055
Engine-drivers and stokers	·294
Supervision	·126
Motormen and inspectors	1·140
Car cleaners	·120
Fuel	·823
Oil and grease	·044
Accumulators	·021
Sand, and various	·083
Car maintenance	·213
Boilers' „	·009
Engines' „	·032
Dynamos' „	·013
Accumulators' maintenance	·073
General	·028
Insurance, legal, sinking fund and general	·290
Total expenses	5·001

TABLE XVIII.—CO. DES TRAMWAYS SUISSES.

GENEVA STEAM TRAMWAYS, 1895.

Expenses Per Tram Mile.

	Pence.
Engineer and foreman	0·1536
Mechanics and stokers	1·78176
Lighting, cleaning, greasing and heating	0·67584
Fuel and Fodder	2·18112
Maintenance of locomotives	0·79872
„ „ cars	0·49152
Tools and various expenses	0·12300
Average total	6·20544

GENEVA HORSE TRAMWAYS.

Expenses Per Car Mile.

	Pence.
Engineer and foreman	·07680
Stable attendance	·47584
Drivers	·98304
Lighting, cleaning, greasing and heating	·21504
Food and litter	2·04288
Renewal of horses	4·1472
Shoeing	·16896
Veterinary surgeon	·06144
Harness and accessories	·19968
Maintenance of cars	·23040
Tools and various expenses	·06144
Average total	5·13024
Number of cars	51
Length of track, horse and steam combined	8·63 miles.

GENEVA ELECTRIC TRAMWAYS.

Per Car Mile.

	Pence.
Engineer and foreman	·1536
Motorman	·78336
Lighting, cleaning, greasing and heating	·16896
Motive power	1·96608
Electrical equipment of cars	·47616
Maintenance of cars	·23030
Tools and various expenses	·16896
Average total	3·94752
Length of line	3·38 miles
Number of motor cars	10
Car miles run	150,000

same basis. It must be remarked, however, that in this case the steam line's expenses are given per train mile. These trains are composed of from two to three carriages, but it is not fair to say that a train mileage if run with trains of two cars is equal to double that amount of motor car mileage, the approximate value being more like three trail cars to one motor car mile. Taking this basis it will be found that the steam lines are still much more expensive to work than the electric lines, and this is so much the case that the company who owns these lines is now engaged in transforming most of its existing steam lines into trolley lines. In this case also the tramway company is bound to buy power from the electric lighting station, the latter being the property of the Corporation. The electrical current is generated by turbines directly coupled to the railway generators. The electrical plant was put up at the expense of the Corporation, the specifications, however, being furnished by the Tramway Company. The electrical power is furnished at the cost of 1·15 pence per Board of Trade unit, the Tramway Company guaranteeing to take at least 500,000 units annually. The Corporation have bound themselves to pay the Tramway Company eightpence for every car mile which

Milan Tramways.

the latter may not be able to run through any fault that can be traced to the Corporation.

Table XIX. gives the average expenditure per train mile on the steam tramways which run throughout the Canton of Geneva.

It is hoped that the above figures will help to bring home the great advantages which electric traction possesses over

Table XIX.—Average Expenditure in Pence per Train Mile in 1894 on the Narrow Gauge Steam Railways in the Canton of Geneva.

Per Train Mile.

	Pence.
Administration	0·84
Maintenance and repairs of permanent way ...	1·40
Traffic expenses	2·13
Locomotive management, wages of drivers, stokers, cleaners, &c.	3·2
Fuel, oil, water, sand, &c.	3·52
Repairs and renewals	1·15
Miscellaneous	0·16
Various expenses	1·32
Total pence per train mile	13·72

all other methods of propulsion, and to convince the reader that whatever may be said to the contrary the conditions that maintain on this side of the water are not essentially different to those which maintain in America, and that the probabilities are that electrical traction will prove even more advantageous in England than elsewhere. It is quite safe to say that where other systems of traction but just pay working expenses, the introduction of electricity will enable a handsome dividend to be paid on a very much larger capital expenditure.

CABLE-LAYING, STUFFED BIRDS, BEETLES, AND MEN.

This, I may remark, is all about Mr. Alexander Siemens's lecture at the Royal Institution last Friday. From the very first we had indications that Sir Frederick Bramwell, the chairman, was qualifying as a rival of Lord Kelvin's in the art of top-spinning. It may be remembered that some years ago Lord Kelvin spun a top—fancifully called a gyrostat—on the floor of the Institution of Civil Engineers during the course of an inaugural address to the Electrical Engineers. Maybe Sir Frederick means to go one better, and that his first actual performance will be on the floor of the House of Lords, amongst his future fellow peers, to give them an idea of treats to follow. Last night was, therefore, merely a dress rehearsal. However, he conducted Mrs. Siemens to her seat at a high speed, and in a very determined manner, as much as to say, "You *shall* hear your husband, whether you like it or not."

Similarly, Mr. Alexander Siemens had evidently been well trained and brought up to the post in capital fighting form. He dashed up with wonderful alacrity, and before we knew where we were, had disburdened himself of at least 100 words at one mouthful for fear that we should escape by some secret passage to the roof, such as are provided for emergencies in all well-regulated establishments.

It was with some astuteness that our attention was called at an early stage to a curve showing the temperature experienced at different periods of the expedition. The gas in the theatre, and the apparent drowsiness of everybody during the moments of waiting had already produced a wonderfully soporific effect, but when we were started off from Woolwich at a temperature of 96°—anyhow in our dazed condition 96 appeared to be opposite Woolwich on the curve—a period of calm and stupor fairly set in. A more effective mental drug could not have been dispensed. In case of further medicine being necessary, our attention was called to a thermometer under the officers' bridge.

However, attached to a steel wire, we were soon lowered down in the sea (which had a salutary result for a moment or two), participating in all the joys of James's submarine sentry—at least such would have been the case had friend James felt in the humour for work; but no, Mr. Siemens required to explain the various things that James had left undone which he ought to have done—such as sounding a gong to announce the discovery of the bottom, not of dinner. As Mr. Siemens put it, he was in no luck.

A twinkle in the Bramwellian eye was noticeable at this moment, which clearly said "You didn't think you were going to get that sort of article to work at the Royal Institution, did you?" It occurs to me that it might be taken as understood that no experiments or operations are to be expected to be effective here. The devil, or some objectionable person, obviously holds a sway, for is it not a matter of history that from the beginning of all things, even the immortal Michael Faraday was never able to induce an experiment to behave nicely at this historic institution?

The expeditionary forces having been again fished up to the surface, we were conveyed in ss. *Faraday* to the Amazon river. No sooner had we got there than we were speedily brought back (at a rate altogether beyond the power of an average cable ship) to Brighton, Portland Bill, and other haunts of vice. This, it turned out, was only as an intermediate "fillip up," and to make us properly appreciate the breadth of the Amazon. It is wonderful how inappreciative we are of the wonders of the tropics, unless brought home to be educated in between whiles.

D

Talking of the dear old penny steamboat (as I have heard —without "the dear"—the *Faraday* irreverently called), it was clear that our lecturer did not mean to let us off her full dimensions, for at one moment he looked up almost angrily, as though we were at fault for their being nearly forgotten, and then out the figures were doled at lightning speed, evidently producing a state of relief to the chest that threw them off.

This good ship appears to have performed the Lionel Brough trick mid-Amazon several times over, and to have made herself generally disagreeable to all the trees that came in her way.

A very usual experience in various sparsely-explored regions seems to have formed a pleasant recreation for the hydrographer of the expedition, by enabling him to plot out all the points where the *Faraday* would have been ashore had the chart been correct. However, she appears to have taken a seat for awhile on one occasion; this owing to a difference existing between hard-a-port and hard-a-starboard. With a foreign pilot on board in a tropical climate, an excellent test of the temper will be found. It may be remarked incidentally that whereas in our country we mean the ship's nose is to be turned hard a port, when such instructions are given; in most other countries, the equivalent to these words refer only to the movement of the wheel (in the absence of a tiller), and, therefore, have an exactly opposite effect. Thus, with an English officer and a foreign pilot, either a high-class collision is provided, or else a first-rate free fight takes place on board. The ship's officer does well to provide himself with a revolver, and stand over the helmsman with it whilst giving his orders. This has been frequently found to obviate all little unpleasantnesses, though occasionally leading to an untidy death.

One of the treats of the evening was the excellent collection of lantern slides. Certain houses were spoken of as being of "quite respectable size." I trust they were respectable in every sense. In some instances, the various subjects which they illustrated were referred to lightly as "This is the House that Jack Built," "This is the shop where they buy things," and so forth; but in others, Mr. Siemens told us they would speak for themselves. They did not, however, deign to do so in all cases, no more did the cable—at least, such is my impression. Still, a specimen was lying on the table to be caressed by the audience, though silent; which was, I believe, very proper, as being truly emblematic of its present fickle humour. Maybe, in the words of Silvie, or Bruno, *à propos* of the bear without a head:—

> "Poor thing," he said, "poor silly thing;
> It's waiting to be fed."

Perhaps the same applies in the case of the Amazon river cable.

Four extra steamers were rapidly "fizzed off" from the lantern, and potatoes, onions, and cabbages from the speaker, as the main produce of the land. Then came the duck episode, in which Mr. Siemens told us that certain members of the staff during idle moments set forth to catch a duck, but apparently the duck was not to be caught in this way, for there he was. The natives in the Amazon river have a special combination method of hunting-fishing-shooting a turtle, which the lecturer referred to; naïvely adding, "This is the way we were *told* it was done, though after watching a great number of times, none of us ever had the satisfaction of actually bearing witness to the fact." It is true the science of cable laying was not exactly unravelled to us; but a suggestion of the whitewash employed appeared to be excellently reproduced on the slides. The views clearly proved that those who had supposed the *Faraday* would have any difficulty in proceeding right up the Amazon river (three miles broad in parts), based their calculations on insufficient data; for some of these actually showed, in a very striking manner, the good ship's nose almost digging into houses close on to the river's bank.

After the lecture had been brought to a successful termination, an adjournment was made—not to tea and cakes; oh, dear no, that is not the way of the Royal Institution. Mental instruction is kept up in Albemarle Street to the bitter end, and in place of the Great George Street repast, we were passed through a course of stuffed birds, butterflies, moths, beetles, grasshoppers, hairy spiders, *et hoc genus omne*, in glass cases. From the number of these I calculated that each member of the ship's crew must have "signed on" to bring home in safety at least 17·3579 of each creature.

Cable-layers did not gather together in great force on this occasion. However, Mr. F. and Mr. T. kept their weather eye on the proceedings, but where was Mr. C., of this now almost classic combination? Even the white waistcoat was not there—in a glass case, or otherwise. Maybe Mr. C. was represented by Mr. D. (being, you see, the next letter of the alphabet) with a galvanometer under one arm and a grapnel under the other. Then there was Master R., who appeared to be telling everyone all about it. Mr. G. S. was also to the fore, as well as the ever genial secretary—which secretary this means will be obvious. The expression is stereotyped, but none the less pleasing facially speaking. Mr. W. H. P. was not to be found—however, obviously two people cannot take the presidential chair.

There were several present who looked as though they ought to have just returned from cable-laying, even if they hadn't. Altogether, an exceedingly pleasant evening was passed, and a general thanksgiving to Mr. Alexander Siemens, not on account of any allusion to submarine cables, but by reason of the formidable display so admirably adapted to a Royal Institution audience.

To be serious: As regards the expedition, probably this was one of the most interesting of its sort which has ever occurred, and it appears to have been carried out in a manner such as well maintains the high reputation of Messrs. Siemens Bros.

An Amazonian Faraday.

A NEW TRANSMISSION DYNAMOMETER.*

By S. W. ROBINSON,
Professor of Mechanical Engineering, Ohio State University.

(*Concluded from page* 627.)

Table I. shows that readings from the instrument mentioned are very readily corrected, it simply requiring five to be deducted.

The diagram also shows that the various results of observation plot very near to a straight line lying at an angle of 45°, there being a close agreement between the various observations. Each new instrument should have a correcting diagram of some kind made out for itself, as the law of each instrument may differ from that of another.

Table I.

Giving corrections for readings taken from the transmission dynamometer in use at the Ohio State University.

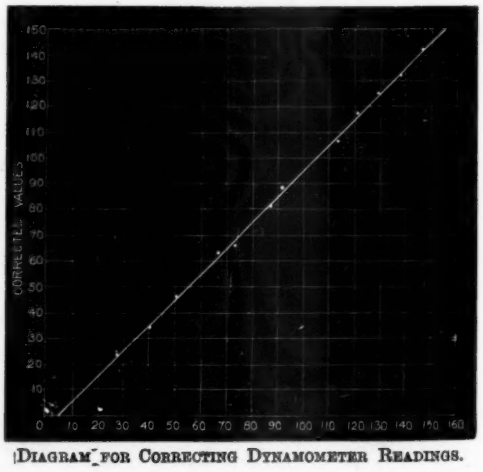


Diagram for Correcting Dynamometer Readings.

Table II. is an example of results of observations for determining the horse-power required to drive a ventilating fan of about 5 feet diameter.

The figures in the column of readings are the means of several readings, and hence the decimals.

The corrected readings are obtained from Table I. for correcting the readings of this instrument which gave these results. The Table I. shows that 5 is to be subtracted, simply from each reading, thus explaining the difference between columns 2 and 3. Hence in column 3 we have the foot-pounds per revolution of dynamometer pulley. Before correcting, we have, as readings, the figure 310, which means that three of the 5-lb. weights had been passed over from one scale pan to the other, making 300 foot-pounds per revolution while the poise bar read 1 or 10 foot-pounds per revolution, making 310 foot-pounds per revolution as uncorrected.

TABLE II.

POWER REQUIRED TO DRIVE A VENTILATING FAN.

Size of fan orifice.	Dynamometer readings.	Corrected dynamometer readings, foot-pounds per revolution.	Revolutions per minute.	H.P. to run fan.
1 foot	310·0	305·0	336	3·11
2 feet	285·3	280·3	432	3·70
3 feet	259·3	254·3	444	3·40
4 feet	127·6	122·6	328	1·22
4 feet	214·5	209·5	450	2·86
4 feet	224·5	319·5	440	2·93
4 feet	256·0	251·0	460	3·50
4 feet	254·1	248·1	490	3·68

But other instruments may not always give readings, the correction for which will be 5 to subtract, but some figure to be determined by calibration, similarly as was done for Table I.

Among the advantages of this instrument may be mentioned its adaptation for receiving the belts from any direction as down from above, from one side, or up from below. In each case, the most advisable arrangement is to place the cross-tree, on which the pulleys are mounted, in such position that both belts will be tightened by swinging it in one direction, or loosened by swinging in the opposite direction, the belt to take the power force to the machine to be measured being that from the pulley on the longer arm of the cross-tree. Then the belts can be adjusted any time to be just at the desired tightness without relacing, and by simply swinging the cross-tree arm.

Formulæ for the dynamometer will be found useful in practice. To this end take

D = diameter of the belt pulley (driven pulley).
R = radius of gear on that pulley.
r = radius of the intermediate gear, and radius of crank arm.
l = half length of poise bar.
W = difference of weights on scale pans.
w = poise weight, "reduced" to scale pan.
F = difference of belt tensions on driven pulley.
T = tangential component of pressure between gear teeth.
f = pressure against crank pin.
n = number of revolutions of pulley per minute.
S = square ft. of belt per H.P. per minute.
u = width of belt on dynamometer pulley.

Then

$$f = 2\,T = 2\,F\,\frac{D}{2\,R} = \frac{F\,D}{R}$$

$$f\,r = (W + w)\,l = \frac{F\,D\,r}{R}$$

$$\frac{\pi\,D\,n\,u}{S} = H\,P = \frac{F\,\pi\,D\,n}{33{,}000}$$

or

$$\frac{F}{33{,}000} = \frac{u}{S}$$

and

$$(W + w)\,l = \frac{D\,r}{R} \cdot \frac{u}{S} \cdot 33{,}000$$

In the 25 H.P. instrument at the Ohio State University mechanical testing laboratory, $D = 14$ inches, $R = 5$ inches, $r = 3\frac{1}{2}$ inches, $l = 23{\cdot}54$ inches, and $u = 6$ inches.

Then, taking the highest value of n at 1,000, and solving for S, we have

$$S = \frac{\pi\,D\,n\,u}{H\,P} = \frac{3\frac{1}{7} \cdot \frac{14}{5}\,1{,}000 \cdot \frac{1}{2}}{25} = 73{\cdot}3$$

giving 73·3 square feet of belt per minute passing over the pulley when the instrument is working to its highest capacity. This figure is more ample than the 60 determined by J. H. Cooper as a fair value some years ago.

The quantity of weights to accompany the instrument is

$$W + w = \frac{D\,r}{l\,R}\,\frac{u}{S}\,33{,}000 = 82 \text{ lbs.}$$

as found by substituting and reducing.

Making the weights of 5 lbs. each, and allowing 10 lbs. for the equivalent of the poise weight, we find we require a trifle over 14 weights, but propose 14 as the number to go with the instrument.

In this case seven or less may be placed on each pan in starting an experiment, the poise weight being at the centre. This collection of weights on poise bar will serve as an efficient inertia damper to check jerky movements of the poise bar, and reduce demands upon the dash-pot.

Then, as above explained, proceed by moving the poise weight slowly out to the end of the graduation, 10, if not sooner balanced by the power transmitted. Then move the poise weight back to 0, and move over a 5-lb. weight from one pan to the other, which amounts to 10 in effect, and equals the effect of the poise weight just returned to centre; then move the poise weight out again to 10, if not sooner balanced; then moving it back to 0, and transfer another 5-lb. weight from pan to pan, and so proceed till the balance is obtained between power and poise bar. Then count up the weights moved over, each being counted for 100 foot-pounds per revolution, allowing the same for the poise weight clear out, as already described in the previous example. If four weights were moved over, they would count 400 foot-pounds per revolution, and if the poise weight were clear out it would count 100, or 500 foot-pounds per revolution in all. Or if the poise weight were at 3·7, the count would be 437 foot-pounds per revolution, &c. If running at 100 revolutions per minute, the H.P. transmitted would be

$$\frac{43{,}700}{33{,}000} = 1{\cdot}324 \text{ H.P.}$$

THE MANHATTAN ENCLOSED ARC LAMP.

THE Manhattan enclosed arc lamp (which is known in this country as the "Jandus," and controlled by Messrs. Drake and Gorham), has been commercially on the market for one year and a half, during which time the Manhattan General Construction Company gradually built up the reputation of enclosed arc lamps to such a degree that the principle of enclosed arc lamps is now acknowledged to be correct.

Since starting, says the New York *Electrical Engineer*, the company have placed in service up to the present time about 7,000 Manhattan lamps, and have had the lamp adopted by 100 direct current central stations. Of course, the adoption of the lamp by all of these companies was after thorough tests under every possible condition of service, and the growth of the business is extending month by month.

In regard to the matter of saving of carbons; after burning for 150 hours there is sufficient left of the upper carbon to use for a lower carbon for the next run, so that on the basis of 10 hours per day, the cost of carbons for one year with the Manhattan lamp (at $25 per 1,000 12-inch carbons) will not exceed 50 cents per lamp per year, whereas in commercial work where the average burning of lamps is less than four hours per day, the lamp will only require for 300 days' service about eight carbons per year, or 16 cents per lamp per year for carbons.

In regard to saving in labour, it is, of course, governed by the service in which the lamps are used, and their distribution. Theoretically, there would be almost the same proportionate saving in labour as in carbons, but in practice it is found the saving, on the average, is about two-thirds, so that the saving

on commercial and street lighting service might be given at from $10 to $15 per lamp per year as a minimum.

The best figures in the way of verification in the above deductions from the Manhattan Company's experience are as follows:—The Brooklyn Edison Company have made up figures on the saving from 350 Manhattan lamps which they use in street lighting service, and they report a saving of about $15 per lamp per year, although this saving shows somewhat in the lamp's favour for the reason that 100 of the Manhattan lamps displaced twin street lamps, taking, of course, more carbons, although smaller than the single lamps.

The Boston Edison Company have 200 Manhattan lamps in commercial service. They report an average burning of 3·64 hours per lamp per day, and figure a saving from between $11 to $12 per lamp per year.

Profs. Houston and Kennelly have made a test on the candle-power of the Manhattan lamp, and also examined the diffusion of light. These tests were referred to in one of our recent issues.

It might be well to add a word in regard to the efficiency of the enclosed arc lamp, as many seem to not be able to figure correctly and comparatively between the enclosed arc lamp burning singly and the ordinary open arc lamp burning two in series, on account of the fact that the enclosed arc lamp takes only one-half the current of the two in series lamp. With Manhattan lamp on a 110-volt circuit, there is a permanent resistance taking up from 28 to 30 volts, which at 5 amperes makes 140 to 150 watts consumed in the resistance. In open air arcs there is a permanent resistance absorbing 13 to 15 volts in each of the pair of lamps running at 10 amperes, or there is consumed in the resistance from 260 to 300 watts for the pair, or 130 to 150 watts to each lamp, so that it will be seen that the efficiency of enclosed and open air arc lamps is practically the same.

One of the main features of the Manhattan lamp is the fact that there are employed double globes, both of which are practically tight. The outer globe being entirely enclosed, of course acts as a thorough protection against weather, but in addition the outer globe acts as a storage chamber for the inner globe or chamber of high rarefaction, and makes the egress of air containing oxygen into the inner globe and to the carbons very slow.

THE RÖNTGEN RAYS.

In his recent lecture at the Royal Institution, Prof. S. P. Thompson said that the only essential difference between the Lenard rays and the Röntgen rays was the difference in their behaviour in the magnetic field. The Lenard rays, as is well known, are bent across the magnetic lines of force, whereas as yet no one has succeeded in producing any effect by a magnet on the Röntgen rays pure and simple.

M. Lafay, however, has succeeded in deflecting the Röntgen rays when they have previously been passed through an electrified metallic plate. These investigations of M. Lafay look as if they were to throw a considerable amount of light on the mystery of the X rays. His earliest experiments we have already described*, and we shall now give some account of his more recent results. It had been suggested that in M. Lafay's first experiments the deflection of the rays had been due to the combined effect of the electro-magnet and the electric field developed by the electrified silver plate. To remove this uncertainty, the electrified ray was caused to pass into a Faraday case connected to the earth before being subjected to the action of the electro-magnet. This case excluded external electrostatic influences; but the deviation of the rays took place as before. A similar experiment to that of M. Perrin, in which he projected the cathode rays into a Faraday can, was tried by M. Lafay with the electrified X rays. The Faraday can was fixed on the rod of a gold leaf electroscope, and the apparatus was enclosed in a metallic cylinder, the upper opening of which is closed with a leaden cover, which has a central aperture. Above this aperture was arranged a silver plate connected to a Wimshurst machine, which served to electrify the rays emitted by the Crookes tube placed above.

In these conditions the Faraday can was charged with electricity of the same kind as that supplied to the electrified plate. The phenomenon does not take place if the aperture in the lead case is closed by a plate of a substance opaque to the X rays, but it is not interfered with when a plate of a transparent material such as paraffin is used.

In a communication presented to the Academie des Sciences on April 20th, M. Lafay states that he has found that when the electrometer is charged, and the previously electrified plate is put to earth, then the charge flows back from the electrometer to the earthed plate. In fact, the air between the electrometer and the plate, when traversed by the X rays, behaves like a conductor of high resistance. He finds also that the charge and discharge are more rapid the more transparent the metal screen is.

When the electrified screen was removed, M. Lafay found that usually a small positive charge was still communicated by the rays to the electroscope, but it amounted to only a twentieth or thirtieth part of the former charge. From this he concludes that the X rays emitted from the Crookes tube are generally, though not always, positive rays. The feebleness of the electric charge in the ordinary rays may account, he thinks, for the failure to obtain any deflection of these rays with the magnet. The electric charge of the rays will also be rapidly dissipated within a short distance of the tube, owing to the conductivity induced in the surrounding region. M. Lafay finds also that the rate at which an electrified screen dissipates its charge is proportional to its density, and that the best dissipators are the best absorbers.

It is a disputed question, and one of great theoretical importance, whether or not the cathode rays inside the Crookes tube will impress the photographic plate. Prof. J. J. Thomson is said to have found that they did not; but, unfortunately, we do not know the exact conditions of his experiment. Goldstein, on the contrary, is said to have shown by numerous careful experiments that the photographic plate *is* impressed by the cathode rays. This latter conclusion has been recently confirmed by M. De Metz, who describes his experiments in a paper presented to the Academie des Sciences on April 20th.

M. De Metz constructed a Crookes tube cylindrical in form, and in two halves, which fitted together air-tight by a ground joint. In one half of this tube was the anode in the form of a ring, and the cathode in the form of a spherical mirror, while the other half contained the little dark slide containing the sensitive paper or films. The object to be photographed—a cross of copper—was laid on the sensitive film, and the dark slide closed by a shutter of cardboard or aluminium. The vacuum was maintained by a Sprengel pump connected up to the tube during the experiment. A dozen photographs, similar to the Röntgen photographs, were obtained by M. De Metz with this apparatus. The cathode rays were found to penetrate aluminium, cardboard, &c., just like the X rays.

M. Poincaré considers that M. De Metz's experiment does not show that the cathode rays have the essential properties of the X rays, because the cathode rays, when they strike the aluminium which covers the sensitive paper, will generate X rays, and that is these X rays, not the cathode rays, which act on the plate. This criticism appears to beg the question. If the X rays are present in the cathode rays, and are merely deflected or diffused by the anticathode, M. Poincaré's objection falls to the ground.

Mr. E. P. Thompson has made an attempt to estimate the candle-power of the X rays. He measured the distance from the Crookes tube at which a phosphorescent screen was illuminated, and found that it was about 6 feet. Then he measured the distance from a candle when the screen ceased to phosphoresce, and found it to be 120 feet. From this he concludes that a candle is 400 times more powerful in producing fluorescence than the Crookes tube which he tested.

Prof. Rowland is not yet quite satisfied as to source of the X rays. Some interesting experiments which he has made point to the conclusion that the anticathode must also be the anode before it will act as a source of X rays. This does not quite agree with results obtained by other experimenters, but no doubt many of these apparent contradictions are due to the experiments being made with different vacua.

Dr. Macintyre, of Glasgow, writes to a contemporary that he has photographed and seen shadows of the cardiac area. In the photograph the diaphragm was clearly indicated; the pyriform shape of the cardiac area was well made out, the base downwards the apex upwards, and the right and left borders showed the relationship to the spine and ribs.

* Electrical Review, page 534.

CABLE LAYING ON THE AMAZON RIVER.*

By ALEXANDER SIEMENS.

When it had been decided to connect Belem, the capital of the State of Para, by means of a subfluvial cable with Manaos, the capital of the State of Amazonas, a preliminary journey became necessary, during which landing places at the various intermediate stations had to be selected, some reaches of the Amazon river explored, as no reliable charts exist, and various other details ascertained in order to facilitate the laying of the cable.

This preliminary survey took place in October of last year during the hottest season, when the river was at its lowest; while the cable was laid during January and February of this year, when the rainy season had commenced and the river was rising.

The difference in temperature between the two journeys was on the average not more than about 5½° C. (10° F.), but a great advantage during the laying was the almost continuous presence of clouds, which mitigated the fierce heat of the sun, and kept the temperature at a very pleasant level.

During the cable laying expedition, the daily maximum and minimum temperature was registered by a thermometer hung up under the officers' bridge in the open air, but sheltered from the sun. The water temperature remained perfectly constant during the whole time that the ship spent on the upper reaches of the river, the proximity of the sea lowering the temperature only to a small extent.

A glance at the map of South America explains, without much comment, how immense the volume of water must be which is collected from an area measuring more than 2½ million square miles, for the most part covered with dense forests, and it follows that the temperature of such a body of water cannot be seriously affected by the daily variations such as were observed.

It is extremely difficult to realise the true proportions of this river, but the comparative table in which the dimensions of the principal rivers of the various continents are contrasted with those of the Amazon, will help to show the importance of this great system of natural waterways. With several other large rivers the Amazon shares the fate, that its name changes several times during its long course, and that at various times different affluents have been considered to be the true source of the main stream. Most geographers, however, regard the Marañon as the principal river, a branch of which, called Tunguragua, rises in Lake Lauricocha, in Peru, in 10° 30′ S. lat., and 76° 10′ W. long., although the Ucayale, where it unites with the Marañon at Nauta (4° S. lat., 70° W. long.), is quite as important as Marañon. If the greatest distance from the mouth is to decide the question, then the source of the Apurimac, an affluent of the Ucayale, can lay claim to being the origin of the Amazon, rising in Peru in 16° S. lat., and 72° W. long.

From the Lake Lauricocha, the main direction of the Tunguragua and the Marañon, is to the N.N.W. until the river turns eastward, and shortly after passing Jaen breaks through the Andes, entering the plains of the Amazon valley by the falls of Manseriche, a short distance west of Borja. Its further course is a little north of east, until it pours its yellow waters into the Atlantic under the equator, between the Cabo do Norte and the Cabo Maguari, which are 150 miles apart. This distance is just about equal to the distance from Lands End to Cape Clear, in Ireland, or from Brighton to Falmouth. Even west of the Island of Caviana, which lies in the mouth of the river, together with the Island of Mexiana, and several smaller ones, the width of the main stream is over 50 miles, equal to the distance from Portland Bill to the Cap de la Hague. The part of the Amazon flowing north of the Island of Marajó may therefore be compared in width to the channel, but in depth and volume of water it far surpasses it. It is a disputed question whether the water flowing south of Marajó, commonly called the Pará River, should be considered as part of the Amazon or not.

A network of natural canals, "the narrows," connects the two waterways west of Marajó, but the influence of the tide makes it difficult to decide whether part of the water of the Amazon finds its way south of Marajó or not.

Along the whole course of the Amazon, commencing at the foot of the Andes, a similar network of islands and canals is formed on both sides of the river, as the whole country is almost level, and is consequently inundated during the rainy season for hundreds of miles by the rivers flowing through it. The most notable exception to this general state of things occurs at Obidos, where the whole volume of water is compressed into one channel a little over a mile wide, and said to be about 40 fathoms in average depth.

A sounding taken opposite Obidos, about a third of the distance across the river, showed a depth of 58 fathoms, measured by a steel wire and Sir William Thomson's (Lord Kelvin) sounding machine. As the current of the river averages three knots in the main channel, it is not easy to take soundings by an ordinary lead line, and even with the steel wire an extra heavy weight (33 lbs.) has to be employed, or the results are not reliable. Besides the wire-sounding machine, James's submarine sentinel was used on the preliminary voyage, wherever serious doubts existed about a channel through which the cable was to be laid.

An illustrated description of this apparatus, and its method of operation, was published in the Review some time ago. Usually the sentinel was set at five fathoms, and when it struck a bar the ship was stopped and a series of soundings taken to ascertain the exact depth of water and the extent of the shallow place.

A further difficulty in sounding originated from the soft nature of the soil, which for the greater part of the Amazon Valley is alluvial clay, and allows the lead to sink into it for several feet. In the narrows there appears, however, a bank of hard clay, called Tabatinga, which unfortunately blocks nearly all the branches of the narrows, and creates bars all along the course of the Tajipuru, the main westerly waterway connecting to the Gurupa branch of the main river.

Occasionally the same hard clay forms shallows in the main river, but as a rule the section of all the channels resembles the capital letter U, *i.e.*, the sides are very steep and the bottom flat. In this respect, as in many others, the Amazon differs entirely from the Indian rivers, which build up their beds above the surrounding country, occasionally breaking through their natural banks and seeking a new bed. The Amazon, on the other hand, carries with it only the light clay sediment which forms the solid of the whole valley, and the inducement for the main stream to alter its course is therefore very small, and long straight reaches are the result.

Under these circumstances the largest vessels can ascend the river nearly to the foot of the Andes, but the constantly changing sandbanks at the mouth of the Amazon proper make this approach of the river dangerous, and the State of Para is for obvious reasons not over anxious to have the deep channels properly buoyed and surveyed. This forces all the shipping to enter the Para river, and to pass the narrows if the Amazon is the goal of the journey. In doing the latter the choice for large ships lies between one of the channels (called Furos) with a bar, where it joins the Tajipuru, and a furo, the Macajubin, which has plenty of water, but which winds about in such a serpentine fashion that only ships with twin screws can pass it unassisted. These difficulties are, however, much diminished during the rainy season when the river rises to such an extent as to drive all the inhabitants of its banks into the towns which have been built wherever a natural eminence secured the inhabitants against the flood. Near the mouth the difference is naturally not so great as higher up, where the influence of the tide is felt less, but at Manaos the difference in level between low river and high river exceeds 40 feet.

With all rivers carrying sediment, the Amazon shares the peculiarity that its immediate banks are higher than the country lying behind them, and thus we have in the rainy season the spectacle of the main river flowing between two banks covered with dense forest, and immense lakes stretching out on either side of these banks. These do not entirely dry up during the remainder of the year, so that the whole of the Amazon valley really forms a huge swamp covered with a most luxuriant forest, which below Manaos narrows to a broad belt close to the main river with prairies, called campos, at the back of the forest stretching out to the hills, where the forest recommences. In such a country no land communication of any sort can be attempted, as the tropical vegetation, and the annual inundations of the rivers destroy everything that man places in the way of the natural forces. By water, on the other hand, the intercourse between all habitable parts of the country is easy and expeditious since steamers have been introduced in the year 1853. At that time the journey from Belem to Manaos was shortened from 40 days to eight days, and at present the ocean-going steamers, which do not call at the intermediate places, accomplish the distance in three days.

Belem, the capital of the State of Pará, lies on a branch of the Pará river, called Guajará, which, unfortunately, does not share the characteristic shape of the Amazon and the furos, but forms a rather shallow basin in front of the town.

The harbour and the general aspect of the town, but for the presence of palm trees, do not differ much from a European seaport.

Even the clothing of a good many inhabitants seems better adapted to a colder climate; it is only the airy costume of the ladies, and still more the absence of any costume on the children, that betrays the tropical climate. The harbour of Pará is very full of shipping, and the general build of the steamers is well adapted to navigate the broad waterway of the main river, as well as the smaller and shallower affluents which become more and more inhabited from year to year.

As the cable steamer could not approach close enough to Pará, the shore ends were laid with the help of a barge and a tug, without anything occurring that need be mentioned. By the same means the sections from Pará to Pinheiro, and from there to Mosqueiro were laid, the large steamer laying the section to Souré across the Pará river. These three places are much resorted to by the inhabitants of Pará for their healthy situation, and because they imagine that salt water reaches at least Souré.

At Souré the ss. *Faraday* was anchored at a convenient distance from the shore, so that the shore end might be landed direct from the ship, and as long as the tide was rising this plan appeared excellent. By the receding tide, however, a whirlpool was formed with the ship lying right across the centre, and when it had been turned 17 times in one hour the captain was tired of it, and moved the ship to a safer anchorage.

Another branch of the cable was laid from Pará to Cametá on the river Tocantins, which is 1,200 miles long, but, unfortunately, has some rapids not far from Cametá, which cut off the navigable upper portion of the river from direct communication with the general Amazon system.

Cametá boasts of a fine old church and a number of two storied buildings, indicating the prosperous state of the township.

The first station on the main cable is Breves, the centre of the rubber trade of the islands of the lower Amazon situate in the centre of "the narrows." Between Pará and Breves is only one shallow passage near the lighthouse of Gujabal, and the pilot managed to run the ship aground there; luckily it was low tide, and with the rising tide the ship could be turned.

At Breves the ship was anchored close to the shore, and its stern secured to a tree by a rope, so that the tide could not cause it to swing. Under these circumstances the landing of the shore ends was an easy matter, and soon finished. The ship then resumed its way into the narrow furos, described above, and the night did not put a

* Abstract of lecture delivered before the Royal Institution of Great Britain on Friday, May 15th, 1896.

stop to its progress, as the outlines of the forest were clearly visible against the sky, and the water everywhere more than seven fathoms deep.

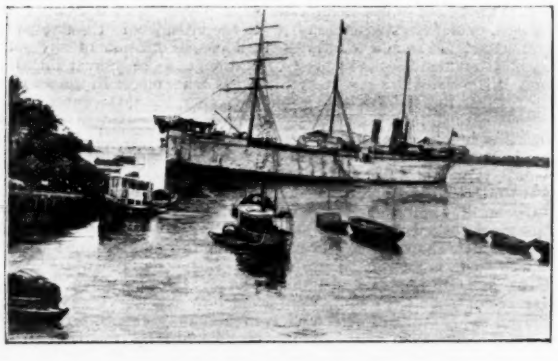
While the speed of the ship was kept at about six knots, the pilot ordered the quartermaster to put the helm a starboard, as he wished to increase the distance between ship and shore. The quartermaster was, however, confused, and put the helm hard a port, with the result that the bows went into the forest, until the branches of the trees touched the fore yard.

To appreciate the situation, it should be mentioned that the foremast stands 74 feet abaft the bows, and that the foreyard is 69 feet above the water level. Luckily the soft ground, the elasticity of the forest trees, and the steepness of the banks, rendered this accident quite harmless, and on reversing the engines, the ship at once came off, so that the laying could be resumed. Not far from this spot the Aturia furo branches off, through which the cable had to be laid, but which was impassable for the ss. *Faraday*, on account of a two fathom bar at the Tajipuru end of the furo.

As a splice had to be made with some cable on a barge, from which it was to be paid out through the Aturia furo, the *Faraday* had to be anchored, and the right hand shore was approached, so as to leave room for the ship to swing round when the tide turned. At the critical moment when the anchor was to be lowered, somebody blundered and turned the electric light out, leaving the anchor winch and its surroundings in darkness.

By the time this mistake had been rectified the ship was dangerously near the shore, and even the anchor could not sufficiently check its advance, so that it ran again ashore, stopping within about 5 feet of a house, much to the alarm of the inhabitants.

This manœuvre fixed the ship in a most convenient position, so that it was left there until the splice had been finished, and the tug *Cochrane*, with the barge, had started laying the cable in the Aturia furo. Again, there was no difficulty in backing the ship off the bank, but the furo proved to be too narrow to turn the ship, which had to return to Breves, or rather a few miles beyond, to the mouth of the Boiuassu in order to enter the furo grande and the Tajipuru in a roundabout way. As the ship was drawing over 24 feet, and the bar at the end of the Boiuassus had only 23 feet of water at high tide, the result was easily foreseen, but the ship remained on the bar for nine days, by which time sufficient cable had been transferred to the barge and to the ss. *Malvern* to enable the ship to continue her journey.



THE CABLE SHIP "FARADAY" IN THE AMAZON.

During this enforced sojourn in the midst of the most wonderful combination of islands and rivers the two naturalists, which the British Museum authorities had kindly sent with the expedition, took full advantage of the opportunity to explore the locality in all directions.

Commencing at the mouth of the river, the first station is Chaves, and the second Macapá; to these two places a branch is laid from Gurupá. The ss. *Faraday* had the distinction of being the first European steamer which has navigated the Amazon river below the mouth of the Tajipuru; in fact, neither the pilots nor the inhabitants knew of any foreign ship that had ever touched at these ports.

In Gurupá, the second station of the main line, the inhabitants expressed their joy at being put in communication with the rest of the world by actively helping in the landing of the first shore end. A young lady in white, niece of the Mayor, borrowed a handkerchief from one of our engineers, daintily laid hold of the end of the cable, and triumphantly carried it into the station. Here a ball was started, and the happy couples waltzed round the cable end to show their appreciation.

Meantime the tug began pulling on the barge from which the cable was to be paid out, and just as these vessels began to feel the current which runs rather strong there, something jambed, the cable would not run out, and the tug could not hold the barge against the current. Barge, tug, and cable, drifted down stream, the end gradually disappearing out of the station. This contretemps luckily did not disturb the dancers, who continued their rejoicing until the end had been brought back.

Monte Alegre lies on a furo, which, unfortunately, has a shallow bar at its mouth, so that the cable had to be laid in and out by the barge and tug. This furo swarmed with "botos," a species of dolphin much coveted by the naturalists, but the natives do not try to catch them, because they are neither good for food nor useful in other ways; besides, they are remarkably shy and strong.

From there the cable is laid to Santarem, at the mouth of the Tapajos, which presents a strong contrast to the Amazon, on account of its clear waters and tranquil flow.

This river is 1,300 miles long, and is formed by the union of the Arinos and Juruena, rising in 14° 42′ S. lat. and 60° 43′ W. long., in the so-called agnas vertentes (the turning waters) close to the sources of some of the affluents of the Paraguay river. In the rainy season all these waters mix, and it is possible to pass in a boat from the mouth of the Rio de la Plata in 35° S. lat. to the mouth of the Orinoco in 10° N. lat., by way of the Paraguay, the Tapajos, the Amazon, the Rio Negro, and the Cassequiare, which forms a connecting link between the Amazon system and the Orinoco.

From Santarem a branch cable is laid to Alemquer, and Obidos, the next station of the main line, is the last point touched in the State of Pará. It would not be right to leave unnoticed the rubber-gathering industry, which is at once the wealth and the bane of this part of the world.

The implements in use are of the most primitive kind, but the average earnings can easily be £3 per day during the dry season, and the facility of earning so much money with little exertion makes the inhabitants unwilling to engage in more arduous labour.

A narrow path leads from the hut on the waters edge into the forest from one rubber tree to another, the path eventually returning to the hut. The trees are cut on the morning round, and the rubber is gathered in the afternoon. As soon as it arrives at the hut a fire of oily palm nuts (Attalea excelsa) is lighted, and the thin sap thickened in the smoke. For this purpose a paddle is used, on to which the sap is poured with a small earthenware or tin vessel. The smoke soon thickens it, and a new layer is poured on until the well-known flat cakes of India-rubber have been formed.

Owing to the rise of the river during the rainy season most of the huts have to be abandoned, and it can easily be imagined how comfortless they are. Nearly all of them are built on piles, and most of them are thatched with palm leaves. There is hardly any attempt made to cultivate the soil, such as it is, but everything is imported. The ss. *Cametenso*, in which the surveying party went out, was laden with cabbages, onions and potatoes, part of which went as far as Iquitos, in Peru.

Chiefly owing to this want of provisions, and to the generally careless mode of life, the mortality among India-rubber gatherers is very great.

There are two stations in the State of Amazonas Parentins, formerly called Villa Bella da Imperatriz, and Itacoatiara, formerly Serpa.

Just before reaching the former station, the Serra de Parentins is passed, which forms the boundary between the two States. At Parentins the river makes a sudden bend, and the resulting eddy current greatly impeded the work; at Itacoatiara, on the other hand, the bow of the ship was run ashore, and the end of the cable landed direct from the ship.

The town of Manaos has completely changed its character since it was made the capital of that region in 1853. A town, quite European in its features, has arisen in the midst of the forest, and to the benefits of rapid transport, to which it has owed so much, there is now added the characteristic lever of modern progress, the annihilator of space and time—electrical communication.

SULLIVAN'S UNIVERSAL GALVANOMETER.

FOR years numerous attempts had been made to design a galvanometer on the moving coil principle applicable for sea use. This is not surprising when one considers the manifest and marked advantages of this type for shipboard work. Amongst others, we believe that Mr. Herbert A. Taylor, to whom electrical engineers generally owe such a debt of gratitude for his idle wire or electro-magnetic damping arrangement worked in this direction. All attempts, however, to produce a galvanometer of the kind failed, owing to the practical difficulties experienced. Foremost amongst these were the question of balancing the suspended coil for rolling, the sag error due to the weight of the coil, and the disturbance set up by mechanical vibration. Like the problem of squaring the circle, that of balancing a suspended rectangular coil, so that it should remain unaffected by rolling and pitching, was pronounced to be an impossibility, until Mr. Sullivan successfully solved the difficulty by his system which secures immobility of the "spot" in the roughest sea. The beauty of the device from a practical point of view is its simplicity, and the fact that with a very little practice any sea-going electrician of ordinary skill can effect a perfect balance in a few minutes, whereas so very few can balance the mirror of a Thomson marine galvanometer, and with that instrument the operation is at all times an exceedingly difficult and tedious one.

We have heard, indeed, of eminent electricians passing hours and days in the attempt!

All the other and well known troubles which had rendered the moving coil type of galvanometer useless as a seagoing instrument of exactitude have been surmounted in Sullivan's galvanometer. The details of the instrument show a thorough knowledge of the practical requirements of cable work afloat.

We believe that Mr. Sullivan has worked for three years in bringing out and perfecting his galvanometer.

In the ELECTRICAL REVIEW recently we have already given the opinions of several eminent submarine cable engineers, on the merits of the apparatus, and now a number of fresh reports from all parts of the world, and equally eulogistic, have been brought to our notice, and it seems, as we stated would likely be the case, that Mr. Sullivan has achieved a remarkable and unprecedented success. Indeed, like Homocea, it touches the ———.

One of the most important tributes to the efficacy of the galvanometer is that of M. Fournier, who speaks from a winter's use of the instrument in the North Atlantic, as follows:—

"Société Industrielle des Téléphones,
"Calais, *April* 23*rd*, 1896.

[TRANSLATION.]

"My dear Mr. Sullivan,—I have received your letter of the 22nd inst., and have read with pleasure the notices respecting your Universal Galvanometer. They are quite accurate. It is an excellent instrument, and I am entirely satisfied with it.

"Attached in December last to a cable repairing expedition in the North Atlantic, on many occasions on the *François Arago* I had the opportunity of appreciating all the advantages of your apparatus, especially near Flemish Cape, between January and March, where storms are frequent and even daily.

"In the roughest weather, the instrument behaved well, and thanks to its perfect design, the facility of its adjustment, its high sensibility, and its deadbeatness, it was of very great value to me.

"Always ready for use, it fulfils every requirement on board ship. It is excellent for insulation resistance measurements, and the rapidity with which one can make observations adapts it admirably for fault testing. The felt pad which, according to your directions, I placed under the instrument, rendered it absolutely proof against all vibratory influences.

"In conclusion, my dear Sullivan, the 'Sullivan' galvanometer leaves far behind it the old 'marine.' I wish you every success, but at the same time I hope you may never have to use your apparatus off Flemish Cape *in January*."

Mons. Fournier is electrician-in-chief of the Société, and this letter is published with their permission.

CORRESPONDENCE.

To Avoid Misunderstanding.

Will you kindly allow me through the medium of your valuable journal to point out that the "Elieson Accumulator British (Patent) Syndicate" was an abortive syndicate formed some time ago with the intention of acquiring the valuable patent rights in Mr. Elieson's accumulators, which we have since acquired, and that our company is not only doing business, but is doing it with considerable success.

The strong similarity in the title of the company, in respect of which it was stated in your issue of the 8th inst. (page 606) it was to be wound up, will, we are sure, induce you to afford us this means of preventing a false impression arising that the notice referred in any way to my company.

The Lamina Accumulator (Elieson's British Patents) Syndicate Limited,
EUGENE PELLAS, *Secretary*.

Dynamos for Electrolytic Work.

The firm I am with intend putting down a dynamo for electrolytic work of an output of 2,500 amperes at 8 volts, and are informed that dynamos giving this heavy current cannot be prevented from sparking, nor the armature from heating badly.

Perhaps you, or some of the readers of the ELECTRICAL REVIEW who have experience of this type of machine, will kindly inform me if this is correct.

"Enquirer."

Gas Engines and Alternators.

Perhaps you will allow me to call your attention to an error which has crept into the very useful chart of the "Electric Lighting Stations of the United Kingdom," issued with a recent number of your journal.

With regard to Coatbridge, the system there is described in the chart as:—"H.T. alternating current. Mordey alternators driven by Dick, Kerr & Co.'s gas engines." It is quite true that gas engines were put down at first to drive alternators at this station, but were found to do the work so very badly—the lights waxing and waning periodically, and sometimes going out altogether—that the gas engines had to be replaced by steam engines. The gas engines used gave, if I remember rightly, an impulse each revolution, and as the failure of such engines to drive alternators is a matter of interest, as well as of importance, perhaps the makers, or some one who has had an opportunity of studying the case at Coatbridge station would give some particulars as to the cause of the failure.

Gas engines have been put down in a few other places for the same purpose, but in every instance which I have been able to trace failure was the result. It would be interesting to know where—if anywhere—gas engines are at present successfully driving alternators.

J. Enright.

May 19*th*, 1896.

[The error that occurred in the central station list has been pointed out before. No corrections were received from the engineer-in-charge.—EDS. ELEC. REV.]

Horseless Street Bill.

As one of the earliest workers in the horseless carriage movement, and as the only person who has had the practical experience of running a horseless vehicle upwards of 5,000 miles through the traffic of London streets, I should be glad of this opportunity of expressing on behalf of all those interested in this immense industry, which is now looming on us, our grateful acknowledgment to the Rt. Hon. H. Chaplin, the Government, and Lord Harris, for the great attention and care, having due regard to all the interests involved, that has been taken by them in removing the obstacles that have hitherto stood in the way of horseless vehicle traffic. I do not think that this momentous epoch in this great question should be allowed to pass without also some acknowledgment of the services rendered in connection with this matter, by one who has represented the London Chamber of Commerce, and has also been specially able to speak on behalf of the electrical section of the horseless carriage interest, which will have most to do with street and town traffic, as opposed to country road work. I refer to Major S. Flood Page.

Radcliffe Ward.

[The gallant Major will doubtless appreciate Mr. Ward's delicate compliment.—EDS. ELEC. REV.]

Correction.

We notice that owing to some mistake it has been stated in several of the electrical papers that another firm had secured the order for the steam and exhaust pipes and feed water heater for the Hampstead Electric Light Station. We beg to advise you that we have received this order, and our price was £967, including Berryman heaters with special gear for lifting the casing for cleaning purposes.

Wright's Patent Heater Condenser Co.,
HOWARD T. WRIGHT.

May 20*th*, 1896.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

MAY 8TH TO MAY 19TH, 1895.

	£	s.
Aden	12	0
Alexandria. Teleph. mtl.	99	0
Algoa Bay	71	0
Amsterdam	50	0
Bilbao	60	0
Brisbane	12	0
Brussels...	2,724	0
Buenos Ayres	360	0
" " Teleph. mtl.	165	0
Calcutta	484	0
Cape Town	81	0
Delagoa Bay	86	0
Demarara	40	0
Flushing. Teleg. mtl.	50	0
East London	613	0
Gibraltar. Teleg. mtl.	209	0
Gothenburg. Teleg. wire	90	0
Hong Kong	18	0
Madrid	25	0
Marseilles	45	0
Melbourne	95	0
" Teleg. mtl. ...	288	0
Montreal	20	0
Ostend	640	0
Penang. Teleg. mtl. ...	109	0
Port Natal	36	0
Rockhampton	271	0
Singapore	181	0
Stockholm. Teleg. mtl.	288	0
Yokohama	162	0
Total	£7,383	0

MAY 8TH TO MAY 19TH, 1896.

	£	s.
Albany. Teleg. material,	2,634	0
Amsterdam	120	0
Antwerp...	107	0
Bangkok...	63	0
Bombay. Teleg. material	63	0
Boulogne	10	0
Buenos Ayres Teleg. mtl.	120	0
Calcutta	238	0
Cape Town	72	0
Colombo...	218	0
Copenhagen. Teleg. matl.	58	0
Delagoa Bay	81	0
Durban	63	0
East London	210	0
Flushing	43	0
Freemantle	99	0
" Teleg. matl.	850	0
Gothenburg	9	0
" Teleg. wire	52	0
Jersey	130	0
King George's Sound ...	799	0
Launceston	74	0
Monte Video	145	0
Melbourne	171	0
Rosario	644	0
St. Petersburg	617	0
" Teleg. material	1,232	0
Seville	7	0
Singapore	10	0
Sydney	1,145	0
" Teleg. cable	1,050	0
Spezia	110	0
Trieste	6	0
Total	£11,250	0

Central American International Exhibition, 1897.—The London Chamber of Commerce has been requested by the Under Secretary of State for Foreign Affairs (Mr. Curzon) to render such assistance as it possibly can in giving publicity to the Central American International Exhibition which is to be held in the capital of Guatemala from March 15th to July 15th, 1897. In a special despatch to the Foreign Office, British Consul Roberts reports that at the present time the quality of British goods finding their way to Central America compares favourably with other countries, except the United States, still it appears to him that the exhibition might be made a means of yet further introducing British productions, if British merchants would support it. At the present time there is a great demand for machinery and hardware of every description; electric light and motive plant, bicycles, &c. Applications for space must be addressed to the Central Committee at Guatemala before August 31st next, and detailed information may be obtained at the London Chamber of Commerce, Eastcheap, E.C.

Claim for Current Bill.—Before the Lord Mayor at the Mansion House last week, the City of London Electric Lighting Company claimed £16 16s. 2d. from the Brewery Joint Stock Syndicate, of 5, Fenchurch Street, E.C., for current supplied. Judgment for plaintiffs with 2s. costs.

Electric Clocks for Glasgow.—For the past six months Prof. Becker has been experimenting at the Observatory with electric clocks, with the view of an installation that will give uniform time to the entire city, superseding the present unsatisfactory system. A committee, after considering a report submitted by Prof. Becker, has agreed to recommend to the Corporation the removal of the installation working at the Observatory, to the Municipal Buildings, from which, by way of experiment, a central area with 10 wall timepieces will be worked. Should the experiment prove satisfactory, the installation will be extended throughout the entire city.

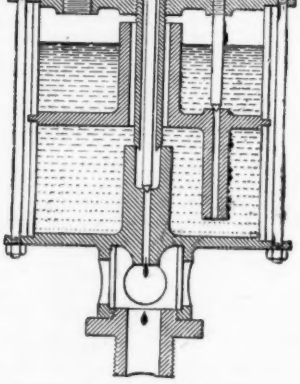
High Speed Noiseless Engines.—Messrs. Redpath and Paris, of Limehouse, E., are the manufacturers of patent high speed noiseless engines for driving centrifugal pumps, blowing, ventilating and exhausting fans; also for driving dynamos for electric lighting, &c., or other high speed machinery. A list which is before us shows the engines as adapted to these various uses, and tabulated particulars give the various dimensions and capacities of engines and dynamos as well as prices of same. Another list, issued by the same firm, is devoted to Thomson's patent combined circulator and feed-water heater for steam boilers. Very successful results have been obtained with the apparatus on board the cable-steamers of the Eastern Telegraph Company. They are fitted to the ss. *John Pender*, the *Mirror*, *Norseman*, *Grappler*, *Great Northern*, and a large number of other vessels.

Horseless Carriages.—The Daimler Motor Company has purchased Messrs. Pear's electric launch works at Eel Pie Island.

Keyway Gauge for Draughtsmen.—This device, which has been found of real service in drawing office work abroad, is now offered for sale in England. It is suitable for either flat or sunk keys. The agent is Mr. Stuart E. McNair, of Croydon.

Liquidation Notices.—A meeting of Clark's Electric Launch Company is to be held at 137, West Regent Street, Glasgow, on June 17th, at 12 o'clock, for the purpose of an account of the winding up being laid before it.

New Sight Feed Lubricator.—Those who have had extensive experience with sight feed lubricators for high speed journals and bearings, will be conversant with the difficulties which up to now have defied all attempts at mechanical filtration, as it is



Vertical Section of Lubricator.

not always deposit which interferes with the continuous working, but often a film of glutinous matter or a minute air bubble forming at the delicately adjusted valve. In Boswell and Carter's self-filtering sight feed lubricator there are two glass-bodied chambers with a division plate between them. The oil is poured into the upper chamber, from which it flows through an adjustable pilot valve down a tube to the bottom of the lower chamber, the pure and lighter oil rising and passing down centre tubes and past the adjustable and stop valves, and is seen dropping through the lantern nipple. The heavier oil or any deposit remains on the bottom of the lower chamber, while any glutinous matter or air bubbles adhere to the sides of downward tube and bottom. If the flow of oil through the pilot valve is interfered with, the reserve of oil from top of centre tube to under side of division plate is drawn upon, and as this oil is used a line of light is seen in the lower chamber below the division plate. Air is admitted to lower chamber through sleeve of regulator valve spindle, and lubricator can be emptied by simply inverting it. The stop valve can be closed without interfering with regulator valve. Mr. S. Boswell, M.I.M.E., of 1, Vere Street, Eccles New Road, Salford, is introducing the lubricator to the market.

Price Lists.—Messrs. Pope, Boddy & Co., of Liverpool, are sending out circulars drawing attention to their improvements in glow lamps.

Water-Tube Boilers.—We are informed that in order to meet the greatly increasing demand for their patent water-tube steam boilers, Messrs. Conrad Knap & Co., of 11, Queen Victoria Street, E.C., have converted their business into a private limited liability company under the name of Conrad Knap & Co., Limited. No shares are offered to the public.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The sub-committee engaged in considering a scheme for the electric lighting of the quays calculate that 70 lamps would be required, but as several of these would also light those portions of the quays for which the city at present pays, it is expected that a proportionate rebate would be made. The cost of electric lighting would, therefore, it is estimated, be about £100 more than the charge for gas, viz., £800, as against £700.

Aberdeen.—The Northern Electrical Lighting Company have asked permission to lay mains under the Deeside Road, from Middleton to Bieldside. A committee has the matter in hand.

Ashton-on-Mersey.—The Board of Trade has informed the District Council that they have issued an order for the electric lighting of the district.

Asylum Lighting.—County Armagh Asylum new buildings are to be lighted electrically. A committee is to report.

Bray.—In consequence of a Committee of the Town Commissioners being absent in London on Parliamentary business, there was no meeting of the board on Monday last, the day fixed for opening the tenders for additional plant for the electric light works. The tenders, of which there are a large number, have not yet been opened.

Bolton.—The balance-sheet in connection with the Corporation electricity department for the last year will be presented to the next Council meeting for approval. The receipts for the 12 months ending March last amounted to £2,451 15s. 2d., made up as follows:—By sale of electricity, less discounts, £2,077 4s.; rental of hired meters, £46 1s. 7d.; and electric fittings trade, £328 9s. 7d. The expenditure amounted to £1,657 10s. 9d., leaving £794 4s. 5d to be carried forward to profit and loss account. The principal items on the expenditure side were £1,081 0s. 10d. for generation of electricity; £29 10s. 11d. for distribution expenses; £249 14s. 8d. for management expenses; and £184 4s. 2d. for rents, rates, and taxes. Bad debts accounted for £14 0s. 5d. The profit and loss account gives the net loss on the undertaking at £1,054 3s. 6d.; but £1,848 7s. 11d. has been paid in interest on mortgage debt (£967 11s. 10d.), interest on overdrawn account (£46 1s. 8d.), and repayment of loan (£834 14s. 5d.). The expenditure on the works and plant to date has been £36,324 14s. 2d.; buildings, engines, boilers, alternators, &c., standing at £26,167 1s. 5d.; transformer mains, &c., £8,981 6s.; and new meters, £1,176 6s. 9d. The amount of loan debt extinguished is £1,415 3s. 1d. on two years' working.

Brighton.—The Lighting Committee has recommended the acceptance of the tender of Messrs. Skeats & Co., Queen's Road, to put up 450 street gas lanterns for incandescent electric lamps for £180, and 8s. for each additional lamp. It is recommended that the electricity main be taken up Islingward Road as far as No. 126, and that the street lamps in that road to that point be fitted with incandescent electric lights. Portions of Eaton Place and Carlton Hill are to be similarly lighted.

Burton-on-Trent.—Owing to increased demand, it has been found necessary to lay down two extra transformers.

Cardiff.—The electric light mains are to be extended from the Infirmary to Clifton Street, and from Canton Bridge, through Cathedral Road, to Plasturton Place.

Chester.—The foundation stone of the electric light works was laid on Tuesday by the Mayoress (Mrs. B. C. Roberts). The site is in the Tower Fields, Crane Street. The buildings will have a frontage to the street of 94 feet. In front will be the accumulating rooms, while the engine and dynamo rooms, and the boiler house, will occupy the space behind, with the coal stores in the rear. The engine room will be lined with brown glazed brick dado with white glazed brick above. The building will be surmounted by a chimney 140 feet high and 7 feet in diameter inside. The structure will cost about £6,000, and will probably be finished in about five months.

Calcutta.—*Indian Engineering* learns that a proposal for lighting Calcutta by electricity, and working the tramways by this agency, has been referred to the Government of India in regard to the question of using overhead wires.

Clapham.—The Surveyor reports that the electric cable across Manor Street and Little Manor Street has been laid by Mr. Singer to his entire satisfaction. Shortly all the principal business firms will have the current laid on their premises.

Colchester.—The Council has accepted Mr. A. T. Osborne's offer to sell for £500 a piece of land adjoining Stanwell Street depôt for the purpose of an electric light station. The plan of the district proposed to be lighted had been prepared, and tenders had been invited from the Brush Company, Crompton & Co., Limited, Christy Bros., Siemens Bros., J. Fowler & Co., and Parsons & Co. The Council has also resolved to accept the Colchester Brewing Company's offer to sell for £100 a piece of land, 72 × 15 feet, adjoining the north side of Mr. Osborne's land.

Coatbridge.—The gas and electric lighting scheme was discussed by the Town Council the other day, and a proposal made by a Committee to purchase the gas works for a sum of £75,000 was rejected.

Coventry.—A statement presented by the Electric Light Committee shows that the electricity supplied during the last quarter amounted to 10,642 units. The rentals amounted to £284 1s., and the number of consumers on March 31st was 50. On the same date the mileage of high tension mains was 2 miles 77 yards, and of low tension mains 2 miles 332 yards.

Dundee.—The Dundee Institute of Engineers paid a visit of inspection to the central station on 14th inst. The company was escorted over the premises by Mr. W. H. Brownlee.

Gateshead.—The Parliamentary Committee has been discussing the advisability of providing the electric light for the borough. A deputation was yesterday to proceed to South Shields, and see what had been done there. The Corporation has lately been in communication with several municipalities on the subject.

Glasgow.—If manifold reports and visits to other towns can make the electric lighting of a city successful, then that of Glasgow ought to be specially so. A deputation is now to visit Birmingham, Manchester, and London, to inquire into the low tension and high tension systems of electric lighting in these towns.

Guildford.—The Electric Light Company has asked to be allowed to make an immediate start on the mains. 979 shares have been actually allotted, and 100 more are applied for, and this more than covers the first contract for the work.

Halifax.—An exhibition of electrical appliances, inaugurated by the Electricity Committee of the Corporation, is being held here until June 2nd, its object being to bring before the public the numerous domestic applications of electricity. Among the exhibitors are Messrs. Ullathorne & Hartley, Messrs. Edward Foster & Son, Messrs. Nunns & Sykes, and J. Sunderland & Co. In addition the British Thomson-Houston Company show a 15-H.P. motor, similar to those fitted to the Bristol electric cars.

Hastings.—The *Hastings Times* understands that the Council in Committee have decided to undertake the lighting of the Front Line by electricity upon the expiration of the present contract with the Electric Light Company, next June twelve months. In addition to the Front, Queen's Road would be lighted from the archway, and, doubtless, other principal thoroughfares would follow. All the existing mains and fittings in the thoroughfares mentioned would be purchased from the company at a valuation. It is estimated that the saving to the ratepayers would be about £1,000 per annum. The power would be generated from the dust destructor at Rock-a-Nore.

Huddersfield.—1895 electric lighting figures will be found in our "City Notes" columns.

Irish Electric Lighting Bills.—A Bill to confirm certain provisional orders made by the Board of Trade under the Electric Lighting Acts, 1882 and 1888, relating to Bray, Cork, Queenstown, Rathmines, and Rathgar, has been sent forward for second reading.

Islington.—Tickets have been issued to the ratepayers to view the electric lighting station between 3 and 4 o'clock on a certain Thursday afternoon.

Kingswood.—The question has been mooted of extending the electric light at Kingswood, but nothing definite has, as yet, been done by the Local Council.

Messrs. Parfitt & Sons have offered to sell their electric lighting plant to the Council, mentioning that the present was the most convenient time for considering any extension of the system. The matter was referred to the Lighting Committee, whose attention was also drawn to several shortcomings of the lighting.

Llandrindod Wells.—The exact terms of the electric lighting agreement with Mr. Davies, who has been asked to postpone the work until September, are to be settled at the next meeting.

Llandidloes.—The Mayor and several of the Councillors think it is time to introduce electric lighting, and propose that tenders for such be invited. After discussion the matter was adjourned.

Lambeth.—We have received copies of letters that have been sent by Mr. W. L. Madgen to the chairman and members of the Electric Lighting Committee of this vestry, one dated April 7th and the other April 29th. Mr. Madgen, in the first, writing simply as a ratepayer, states his anxiety respecting the "giving up the powers for a general supply of electricity in the parish to a company," and respectfully begs "to point out that unless due precautions are taken the above course is liable to commit us to some particular group of financiers and contractors." He then proceeds to argue as follows: "I need hardly say that such privileged conditions are not the most favourable for securing the best machinery and keen buying. They are, in fact, more likely to provide a sale for machinery of such a class as cannot now be sold in any other way." We do not know what machinery it is intended to put down for the lighting of the parish, but we do think it would be fairer if Mr. Madgen told the committee something of his own business connection with manufacturers, consulting electrical engineers, and others, so that a due appreciation might be given to the counsel he bestows in this instance as a "ratepayer." The condition which Mr. Madgen would seek to have expressed in the specification as to "the size, quality, &c., of the buildings, plant, and mains . . . . shall be drawn up by an independent engineer, that tenders shall be invited, and the selections made by your committee," seems to point to certain directions. In the second letter Mr. Madgen quotes, in reference to the subject of average price per unit obtained, half-a-dozen stations run by local authorities "as financially successful;" but we would point out that of those mentioned, Hanley only had a surplus of £71 for 1895 (first year), while of the others Huddersfield had a deficit of £1,373 for 1895) (second year); Lancaster a deficit of £306 for 1895 (first year); Portsmouth a deficit of £419 for 1895 (second year); Worcester a deficit of £1,452 for 1895 (first year); and Yarmouth a deficit of £766 for the same period, also for its first year. These various stations we do not doubt will soon be successes, but at present they are not quite self-supporting, but have to draw from the rates.

Liverpool.—The Town Clerk reports that the Bill for the purchase by the Corporation of the Liverpool Electric Supply Company's undertaking will probably receive the Royal Assent before Whitsuntide, and arrangements are to be made to complete the purchase and transfer on July 1st next.

Lynton and Lynmouth.—It is expected that in August the electric light will be ready for the new Esplanade. The roads have had the light for several seasons, and the hotels and other residences have taken a supply to the extent of the present capacity of the works; a new pumping station is to be erected, so as to obtain additional power for the extensions.

Middlesbrough.—The Electric Lighting Committee recommended the Council not to take further action at present with reference to providing the electric light. Alderman J. A. Jones moved, as an amendment, that the Committee take steps to lay down forthwith an installation at an expenditure not exceeding £21,000. Councillor Forbes seconded the amendment, and a long discussion ensued, which was eventually adjourned.

Mitchelstown.—A committee is considering the advisability of introducing electric lighting.

Paisley.—The Electric Lighting Committee reported at the last Council meeting what progress was being made in connection with the proposed installation of the electric light. The question of whether to at first appoint a resident or a consulting engineer was discussed, and the matter adjourned.

Portsmouth.—At a meeting of the Town Council last week, it was agreed to increase the salary forthwith of Mr. F. H. Chaplin, first engineer at the electric light station, to £110 per annum. The salary of Mr. J. R. Parkinson, second engineer, was increased to £90, and that of Mr. F. T. Rynad, third engineer, to £75. The salary of Mr. E. Price, manager at the electric light station, was increased from £250 to £275 per annum. The Council assented to the carrying of electric light mains through St. Ronan's Road, Southsea, at an estimated cost of £200, and it was decided to apply to the Local Government Board for power to borrow £6,000 for various works connected with the extension of the system. This formed part of £20,000, for which general application was made some time since.

Rhondda Fach.—It is stated that a large section of the residents in this district will take a supply of electricity from the installation of the Ferndale Brewery Company. Numerous applications have also been received by the company from tradesmen in the district for terms for lighting their premises.

Spain.—Tenders were recently invited for the concession for the electric lighting of the little town of Vivero (Lugo) during a period of 15 years, but not a single offer was received. It is stated that the Compagnie Générale Madrilenè d'Electricité has placed a contract with Messrs. Siemens and Halske, of Berlin, for a large quantity of cable required in connection with the extension of the electric light mains in Madrid.

Stafford.—The Finance Committee of the County Council recommended that for the year ending March 31st, 1897, the supply of current by the Corporation for the lighting of the County Council Buildings should be based on 8d. per unit, with a minimum of £175. The Council has, however, not agreed to this. A member suggested that if the Corporation would not supply it at 5d. per unit the County Council should generate its own current.

For the five months during which the electric lighting works have been in existence there was a net credit balance on the working account of £296.

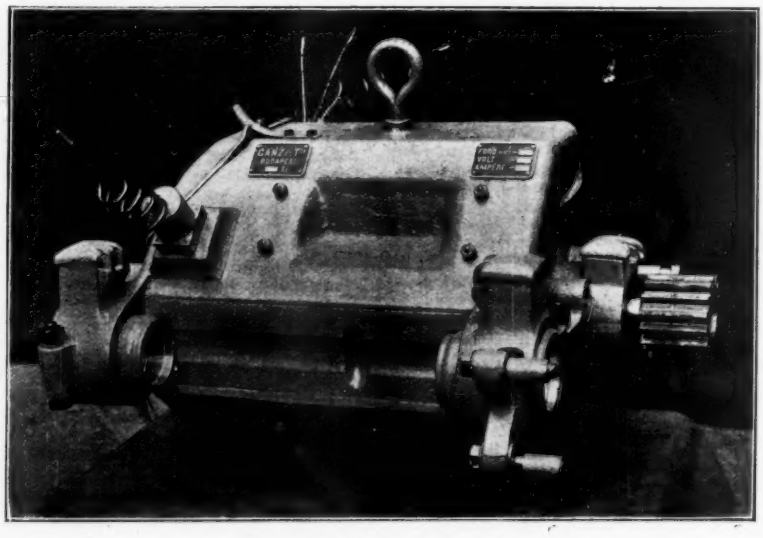
Southampton.—At the last Borough Council, it was reported, in connection with the electric lighting works, that everything was being got on with as fast as possible, in order that the contemplated work might be finished with all expedition.

Sunderland.—At the last meeting of the Council a statement was made by Alderman Bruce regarding the working during 1895, and a proposal to reduce the charge from 6d. to 5d. per unit considered. We refer to this in our "City Notes."

Wakefield.—The Corporation want a clerk of works during the execution of the electric light buildings. Applications to be lodged with the city surveyor by May 27th.

Watford.—The District Council will take into consideration the question of lighting their streets by electricity.

West Ham.—The electrical engineer (Mr. Risch) has reported to a committee regarding a site for a suitable electric lighting station. He recommends for the private lighting the alternating current transformer system, current being generated at about 2,000 volts pressure, and fed to two or three points in the Stratford and Barking Road districts, where transformers would be placed. The current would from thence be distributed on the three-wire system, the pressure on consumers' premises being 100 volts. For the public lighting he proposes to run all the arc lamps in series off one constant current dynamo, and to have all the lamp-posts fitted with incandescent lamps, the latter to be used after midnight instead of the arc lamps. The Council has resolved upon the site recommended by Mr. Risch, and empowered him to arrange with the borough engineer as to the size of boiler house and general arrangements for working both sewage and electric light plant.



Street Car Motor (Ganz & Co.)

Withington.—The General Purposes Committee has had a discussion on the question of the electric lighting of the district, and a deputation has been appointed to interview Alderman Higginbottom, deputy-chairman of the Gas Committee of the Manchester Corporation.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Ashton.—The Town Clerk has received a letter from Mr. Stephen Sellon, the engineer to the promoters of the proposed Oldham, Ashton, Hyde, and District Electric Tramways, asking the present position of the electric lighting question. "It may be that if it was any way forward, some negotiations between us might be advantageous either in the shape of taking power from you for our electric traction installation, or by some method of combination by which economy might be gained by both parties. It appears to me a pity to erect two fairly large electric generating stations, when perhaps the whole thing could be arranged under one roof." The Town Council decided that Mr. Clirehugh should be requested to take the matter into consideration in preparing his scheme.

Cardiff.—With respect to the proposed municipalisation of the tramways, in the course of a discussion by the Committee appointed to deal with the subject, Mr. Robinson said electricity was being introduced as a motive power with the greatest success, and he urged the Committee not to do anything which would prevent their using electricity. The chairman explained that the tramway company was only too willing, if power was allowed, to at once adopt electricity as a motive power, and, further, to take the power from the Corporation.

Dover.—With further reference to the proposal to run the electric tramways down Snargate Street instead of Northampton Street, the officer of the Board of Trade who has the matter in hand has written to the Town Clerk officially stating that the Board would not under any circumstances allow a tramway in such a narrow street as Snargate Street, which was 1,190 feet, with an average width of 14 feet 10 inches between the footpaths.

Dundee.—The question of extending the tramways is under consideration. The Burgh engineer has collected certain information, which will be laid before the Council on an early date.

Nurnberg—Furth.—On the 20th of last month the electric tramway between Nurnberg and Furth was inaugurated. It is about 6 miles in length, and constructed on the overhead system by the Allgemeine, of Berlin. The capacity of the power station is 600 horse-power, of which 200 are kept as reserve. The water for the boilers is pumped by means of electrical pumps from wells situated at a distance of some 500 yards from the power station. The following illustration shows one of the street car motors constructed by Messrs. Ganz & Co., of Buda Pesth. Motor is designed for draw bar pull of 500 kilogrammes, and a speed of 8 miles an hour. The speed for which it is designed is 450 revolutions per minute.

Electric Tramways.—While the County Council has been awakened, says the *Pall Mall Gazette*, to the fact that there is, after all, a great deal in the scheme of the Syndicate to electrify the tramways of London, in spite of the attempt to shelve it, and while we have a company which actually proposes to electrify our omnibus service, Birmingham appears to be moving with even more enlightened rapidity in the same direction. The fact is that bound down by the leases to the jog-along existing companies, we in this country have not moved with the times as they have been doing in other countries. It is not surprising to hear, therefore, that Mr. William Mackenzie, president of the Toronto Railway, and Mr. James Ross, managing director of the Montreal Street Tramways have made an offer to purchase the business of the Birmingham Central Tramways on the basis of par value for debentures and preference shares, and a bonus of £1 on the ordinary shares, which were originally £10, but two years ago were written down to £5. The total amount would be about half a million. In a circular which the directors have issued, they warmly commend to the shareholders acceptance of the proposal. If it all means that the tramway achievements of such places as Toronto, Montreal, and New Orleans are to be repeated in the Midland capital, then is Birmingham thrice blessed. And why should London wait?

Glasgow.—We understand that the Electric Motor Committee of the Corporation has had before it models of the Simplex system of underground electric traction. The patentees gave a full description of the method of working. The principal features are that the wire, instead of being overhead, is under the outside rail of the track. The Committee afterwards investigated the magnetic system, but the whole matter was left in abeyance until further information could be obtained as to cost, &c.

Germany.—We understand that a concession has been granted for building a railway between Bonn and Niederlahnstein. We are also informed that the Tramway Company, of Coblenz, who up to now have been using horses, have decided to go in for the trolley system.

Hartlepool.—The official inspection of the newly-completed electric tramways for the Hartlepools was made on 14th inst. by Board of Trade officials. Two cars were run over the lines between the Hartlepools, the inspectors being accompanied over the route by the Mayors of Hartlepool and West Hartlepool, several members of both Corporations, and the borough engineers. The trams were opened to the public on 19th inst., and well patronised by the public.

Kidderminster.—This Bill came, on 19th inst., before Sir John Kennaway's Select Committee of the House of Commons. Under the provisions of the measure powers are taken to incorporate a company for the construction of tramways to be worked by animal or electrical power, the capital being £60,000 in shares, and £15,000 by loan. The committee passed the preamble of the Bill.

Leeds.—The Leeds Tramways Bill came before the Committee on Unopposed Bills the other day. The Standing Order having reference to the working of tramways by Municipal Corporations having been already suspended, there remained no obstacle to the passage of the Bill, which was passed with a few minor alterations, which do not affect the main provisions of the measure. The effect of the Bill is to enable the Corporation to borrow £407,000 for tramways purposes, and, as already stated, to work the lines themselves.

Tenders are invited by the Leeds Corporation for the erection of an electric power station, for bracket poles and overhead wires, engines, boilers, and tramcars; and, in fact, for all the plant that will be required for the electric tramway from Kirkstall to Roundhay. For further particulars see our "Official Notices."

Light Railways.—The Unopposed Bill Committee of the House of Lords has passed a Bill for light railways between Tunbridge Wells and Hastings (S. E. Railway, length 12 miles, capital £80,000), and one for a light railway in Yorkshire, to be known as the Cawood, Wistow, and Selby Light Railway (capital £32,000).

Swansea-Mumbles.—A report has just been submitted by Mr. Morgan Williams regarding the proposal recently made to the Swansea Corporation by the chairman of the Swansea and Mumbles Railway Company with a view to working the railway by electric power supplied by the Corporation. To run 200,000 train miles per annum would require, says the report, 1,080,000 units per annum. This amount, at 1½d., would come to £6,750 per annum. Running 200,000 train miles by steam would mean 1,200,000 car miles per annum, which, at 1d. per mile, would amount to £5,000 per annum. It will thus be seen that the price of electricity is dearer than steam, and the charge to bring these equal, to be made by the Corporation, will be 1·29d. per unit. "Under these circumstances, I must say that I do not think, with the somewhat limited opportunities of obtaining detailed information that I have had, it would be advisable for you to undertake the conversion of your line from that of steam to electricity, unless materially better terms be obtained from the Corporation."

The City and South London Railway.—The Bill promoted to extend the time for the purchase of lands for the purposes of the City and South London Railway Act, 1893, and for the completion of the underground railway to Islington and other objects, came before a Select Committee of the House of Commons on Monday. The main question before the Committee was the demolition of the Church of St. Mary Woolnoth, for the purpose of erecting a station. Amongst other witnesses called was Mr. C. G. Mott, chairman of the company. The Committee found the preamble of the Bill proved, subject to the insertion of a clause for the protection of St. Mary Woolnoth, and declaring that it shall be referred to the arbitrator to take into consideration the additional liability which will devolve on the company in consequence of giving up their present rights.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (1869, Anglo)	April 6th, 1895 ...	...
" " (P.Q.) ...	June 24th, 1895 ...	...
Brest-Penzance (P.Q.) ...	... ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Ceara-Maranham	April 28th, 1896 ...	...
San Thomé-Loanda	May 2nd, 1896 ...	...
Monte Alegre-Santarem ...	May 5th, 1896 ...	...
Landlines.		
Trans-Continental line beyond Mazal (Mashonaland)	March 12th, 1896 ...	...
Telegrams for Tohikwawa and Blantyre cannot be accepted.		
Indo-European	... ...	May 16th, 1896.
Siberian lines between Chabarowsk and Vladivostock	May 13th, 1896 ...	May 15th, 1896.
Ecuador landlines — St. Elena beyond	May 16th, 1896 ...	May 18th, 1896.
Bolinao-Manila	May 19th, 1896 ...	May 20th, 1896.

Cable Communication.—The following statement by the Secretary of State for the Colonies, in the House of Commons, was made on April 23rd, 1896, in reply to Mr. Tomlinson, M.P.:—"I have received communications from the West India Colonies representing the importance of establishing improved telegraphic communication between this country and those Colonies for the purposes of Imperial defence, as well as for commercial purposes. I have no reason to think that there are any insuperable constructive difficulties in effecting such communication. Proposals on the subject are under consideration, and I hope that they may result in a cable being laid at no distant date." In consequence of the above, a meeting of the London firms on the West Indian Committee has been held, and the following resolution was ordered to be sent to the Secretary of State: "The West India Committee, representing proprietary, mercantile and other interests in the United Kingdom connected with the British West Indies, have observed with much satisfaction the statement recently made in the House of Commons that proposals for a cable communication with these Colonies, *vid* Halifax and Bermuda, have been made. The Committee are of opinion that any such alternative cable, entirely British, would be a great boon to the West India trade, inasmuch as the proposed line would largely reduce the present onerous charge for telegrams between those Colonies and the Mother Country, the charge for telegrams between British Guiana and the United Kingdom being higher than that for telegrams from any other part of the world. The Committee trust that the proposals of the Halifax and Bermuda Company will receive the favourable consideration of Her Majesty's Government."

Coast Communication.—The secretary of Lloyd's, replying to the recently published comments of the Chamber of Commerce of Plymouth on a previous statement from Lloyd's, states that the desire of Lloyd's is that "any further money that the Government can grant (for the object of saving life at sea) should be granted to the extension and improvement of lights and fog signals, rather than to the further extensions of telegraphic communication." This statement is dated April 8th, 1896. The Plymouth Chamber of Commerce, in a reply dated May 14th, asserts, according to the *Times*, that it does not object to the building of additional lighthouses where necessary, but it is at issue with Lloyd's in that "the Chamber insists on the paramount necessity that lighthouses, when built, should be utilised to the fullest extent possible for the saving of life and property by putting them into telegraphic communication with the general telegraphic system of the country."

New Submarine Cable.—Telegraphic connection between Germany and England is to be strengthened by the laying of another submarine cable, 230 knots long, containing four wires, between the Frisian Island, Borkum, and Bacton, on the coast of Norfolk. The cable has been constructed by the India-rubber Company, Silvertown, and will be laid immediately. Supplemental estimates presented to the Reichstag contain an item of 1,280,000 marks, Germany's proportion of the cost within the past three years of telegraphic communication between the two countries.

Trinidad.—At the opening of the Brazilian Congress at Rio de Janeiro, on Thursday, 14th inst., the President stated that he believed that the difficulty with Great Britain regarding the island of Trinidad would be favourably settled.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—May 27th. Tenders are invited for supplying and erecting boilers, feed-water heater pumps, and piping for the Aberdeen Corporation electricity works extension. Copy of specification, conditions of contract, and form of tender may be obtained and drawings seen at the Electrical Engineer's Office, Cotton Street, on payment of £1 1s.

Austria.—June 1st. The municipal authorities of Prague are inviting tenders for the erection and equipment of a municipal electricity generating station in the town for electric lighting, power, and tramway traction purposes. Tenders are to be directed to the Stadrath der Haupt, Stadt Prague, Prague, Austria, from whom full particulars may be obtained.

Belgium.—May 27th. Tenders are being invited for the conversion into electric lines of about 20 kilometres of "Vicinal" steam railways in the Centre district. Tenders are to be sent to the Société Nationale des Chemins de Fer Vicinaux, 26, Rue de la Suence, Brussels, where full particulars may be had for the sum of 1 franc.

Germany.—May 26th. Tenders are being invited by the Hamburg Finance Deputation for the supply and erection of an electric crane. Tenders are to be sent to Die Finanz Deputation, Hamburg, marked No. 91.

Germany.—May 30th. The German postal authorities at Coblenz are inviting tenders until the 30th inst. for the supply of 10,000 telegraph poles. Tenders to Herr Tasche, Ober-Post Director, Coblenz.

Hammersmith.—May 27th. The Vestry invites tenders for cables, pipes, arc lamps and lamp posts, transformers, sub-stations, and overhead travelling cranes. Mr. A. H. Preece is the consulting engineer. For further details see our "Official Notices."

Holland.—May 27th. Tenders are being invited by the Dutch Minister of the Colonies for the supply of a quantity of galvanised iron telegraph wire. Tenders to be addressed to the Ministry of the Colonies at The Hague.

Leeds.—June 20th. The Council require tenders for electric installation for working on the overhead system a 7-mile (double track) length of tramways. A note of the seven sections, poles, conduits, wires, cars, accumulators, &c., will be found in our "Official Notices."

Leicester.—June 6th. Tenders are wanted for the supply of coal cobbles, or nuts, for one or two years ending 31st inst., for the Gas and Electric Lighting Committee. Particulars and form of tender can be obtained on application to Mr. Alfred Colson, M.I.C.E., engineer and manager.

Lima.—June 1st. The Municipal Council is inviting tenders for the establishment and working of the electric lighting in the squares and streets of the city, with power to work the private supply under a 20 years' contract. Particulars to be obtained at the Peruvian Legation, 13, Comeragh Road, West Kensington, W.

Oldham.—May 26th. Tenders wanted for supplying a jet condensing plant capable of condensing 25,000 lbs. of steam per hour, for the Electric Light Committee. Copy of specification may be obtained on application to Mr. Arthur Andrew, Gas and Water Offices, Oldham.

Portugal.—June 3rd. The Royal Company of Portuguese Railways is inviting tenders for the supply of a quantity of "small telegraph material." Tenders to be sent to the Ingenieur Chef du Service des Magasins de la Compagnie Royale des Chemins de Fer Portugais Santa Afolonia, Lisbon. Particulars from office of company, 28, Rue de Chateaudun 28, Paris.

Roumania.—June 1st.—Tenders are being invited by the General Direction of the Roumanian Posts and Telegraphs in Bucharest for the supply of two tons of hydro-chlorate of ammonia and three tons of copper sulphate.

Saxony.—June 10th. The Saxon State Railway Telegraph Department at Dresden is inviting tenders until June 10th for the supply of 60 tons of galvanised iron wire, 12,000 porcelain insulators, and 8,500 zinc cylinders for batteries. Tenders to be sent to the Königliche Betriebs-Telegraphen-Ober-Inspection, Sächsische, Staatseisenbahnen, Friedrichstadt, Dresden.

Spain.—May 28th. Tenders are being invited by the municipal authorities of Penaranda de Bracamonte for the concession for the electric lighting of the town during a period of 15 years. Tenders to be sent to El Secretario del Ayuntamiento de Penaranda de Bracamonte, Spain.

CLOSED.

France.—The French naval authorities have just placed a contract with the Societé Alsocienne de Constructions Mecaniques, of Belfort, for three large dynamos required in connection with the electric lighting of the war vessel *Gaulois*.

Tunbridge Wells.—For the supply of two large boilers, one small one, and a feed-water heater for the Lighting Committee, the tender of Messrs. Babcock & Wilcox, at £1,497, has been accepted.

NOTES.

Seven Days' Hard Labour.—This is the title of a series of columns in *Pearson's Weekly*, devoted to answering the questions of correspondents. Last week one of them, 'L. A. H.," writes :—"Can you inform me how, in the event of a telegraph wire breaking, the operator can tell exactly where the accident occurred without leaving his office?" Nothing in reality could be easier is the light-hearted reply, and there is given the very identical answer which appeared in *Answers* some months ago, and which gave us the opportunity of commenting, in our issue of March 20th, upon the confusion existing in the minds of writers as to electrical terms, which is so characteristic of newspaper science. The man who can send a force of 2,000 ohms along a telegraph wire deserves "seven days' hard." Seriously speaking, however, it is most extraordinary that men, the proprietors of papers which bring them in immense fortunes, should not be more careful to enlist the services of writers who know something of the rudiments, at least, of the subjects on which they expatiate so glibly, but so ignorantly.

National Electric Light Association.—Following is the list of papers read before the recent convention of the National Electric Light Association, New York :—Tuesday, May 5th : "Single-phase, Self-starting, Synchronous Motors," F. H. Leonard; "Equaliser Systems of Distribution," A. Churchward. Wednesday, May 6th : "Results Accomplished in Distribution of Light and Power by Alternating Currents," W. L. R. Emmett; "Evolution of Interior Conduits, from an Electrical Standpoint," Luther Stieringer; "Evolution of the Inductor Alternator," John F. Kelly; "Steam Boilers : Their Equipment and Management," Albert A. Carey. Thursday, May 7th : "Evolution of the Arc Lamp," L. H. Rogers; "Electrolysis," Capt. Wm. Brophy.

Keely Again.—"A.I.O.G.," in the "London Letter" of the *Indian and Eastern Engineer*, writes :—"You are very interested in the Keely motor we know, so the following paragraph, which is going the round of the American papers, will be welcome to you. The stockholders of the Keely motor assembled last night to witness the initial trial of the machine, on which the inventor has been working for the last 75 years. The trial was a complete success. The mechanism of the motor was contained in an old sardine box. Mr. Keely placed three drops of water in an interior compartment, and by the aid of a violin bow produced certain variations (*sic. vibrations*). Instantly the ponderous fly-wheel attached to the box began to revolve, indicating a force of 2,000,000 horse-power. The shafting was attached to the central station of the Baldwin Locomotive Works, and the force was sufficient to turn every machine in the immense place, besides working the city water pumps, and developing enough current to operate the 500 miles of electric traction of which the city boasts. Mr. Keely is to be congratulated on his success, the result of many years of patient toil and an expenditure of $30,000,000."

Röntgen Rays.—"A Symposium on the Röntgen Rays" is the title of an article which appears in the *Century Magazine*, the authors being T. C. Martin, R. W. Wood, Elihu Thomson, Silvanus P. Thompson, J. C. McLennan, W. J. Morton, and Thomas A. Edison. *Nature* describes the result of the article as a vain repetition of experimental conditions, and a confusion of tongues; Professor Thompson referring to pictures obtained by Röntgen rays as "sciographs," while other writers describe them as "shadowgraphs," and all the illustrations are designated "cathodgraphs."

A most successful practical demonstration of the new photography was given in the New Examination Schools, Oxford, on Tuesday the 19th inst., by Mr. J. Hardie McLean, M.I.E.E., and Mr. E. L. Birkbeck Hill, A.I.E.E., to a large and representative audience. Sir Henry C. Mance took the chair.

Artesian Well Boring.—An artesian well was recently bored at Sardinia Street station for the Metropolitan Electric Supply Company, Limited, by Messrs. C. Isler & Co., of Southwark. The well is lined with 210 feet of 10-inch steel tubes, the top being 5 feet below the surface. The water level is 167 feet below the surface. This boring is also lined with 70 feet of 9-inch tube, the top standing 205 feet below the surface. The following are the sections of soils encountered in the boring operations :—

	Ft.	In.	Ft.	In.
Dug well	7	6	...	
Brown clay	4	0	11	6
London clay	79	6	91	0
Sandy clay	30	0	121	0
Coloured clay	36	0	157	0
Mottled clay	4	0	161	0
Stone	4	6	165	6
Sandy clay and pebbles ...	4	6	170	0
Green sandy clay and pebbles	3	0	173	0
Dead sand	23	0	196	0
Green sand	4	0	200	0
Chalk	305	0	505	0

An Immense Belt.—The Chicago Belting Company is constructing a monster belt, the dimensions being as follows :—Length, 150 feet; width, 7 feet; weight, 3,300 lbs.; thickness, $\frac{7}{8}$ inch. In its construction, the selected portions of 450 oak-tanned hides, picked from over 5,000 skins, were used. The belt is to be used in the engine room of the Louisiana Electric Light Company at New Orleans, where it will be attached to the 28-foot driving wheel of a great Allis-Corliss engine. A Chicago exchange says that this is confidently stated to be the largest belt ever constructed.

Electrical Fatality at Bedford.—An employé, named Bates, of the Corporation Electric Lighting Department, was working at the St. Mary's transforming station on Friday morning last, when his left hand came in contact with the high tension wires. Death was instantaneous.

The engineer at the electricity works (Mr. W. J. Hope-Johnstone), in reply to our inquiries, says :—"The accident was caused through a tear or puncture in the insulation of the cable."

Reporting the American Conventions.—For the purpose of reporting the Conventions from the main office in Chicago and St. Louis, from 25 to 50 main wires will be laid from the office in the Convention Hall to reach to every point in the country. These will receive current from the dynamo plants of the main offices, but otherwise have no function in the main offices, no repeaters being used. In other words, they will be independent of the main office except for current. From 40 to 50 operators will be kept busy, and multiplex instruments will be largely used. A force of messengers, in number from 50 to 75, will keep open the lines of communication, not only for the Press but for the delegates. Near the chairman's table will be a force of special Western Union reporters, who will relieve each other, and whose sole duty will be to prepare bulletins. These reporters will be provided with a pneumatic tube, the plant for which will be run, probably, by a small motor. This tube will put them in almost instantaneous communication with special operators, and the proceedings will be reported throughout the country with the least possible delay. During the day the Convention Hall office will handle private messages, bulletins, and Press reports for the afternoon dailies. It is anticipated that about 50 million words will be sent.

The Inclosed Arc Lamp.—In an article on "Convention Topics" the New York *Electrical Engineer* remarks that the papers read there would bear discussion, but draws attention to other things which it might be more advantageous to dwell upon. An interchange of opinion on the inclosed arc lamp would be eminently timely. This type of lamp, which was first practically shown in operation at the Washington Convention two years ago, is gradually but surely gaining its way in public favour, and those who have not already looked into its workings with a view to its adoption ought to be able to gather valuable information from those who have already taken it up commercially. That the inclosed lamp has come to stay there cannot be the slightest doubt, and in Brooklyn, for instance, where 350 such lamps have been employed in street lighting service, a saving of $15 per lamp per year is reported. In these days of close competition and so-called anti-monopolistic city councils, $15 per lamp per year may mean a difference between a profit and dead loss. To be sure there are still some difficulties in the way of the application of the inclosed arc lamp to series arc circuits, but our contemporary believes that even these in time will be removed, so that they will largely replace the open arc, now universally employed.

Kew Observatory.—The Royal Society Kew Observatory Committee report for the year 1895 states that the magnetographs have been kept in constant operation throughout the year, but no very exceptional disturbances were registered during that period. Various experimental investigations have been carried on, in addition to the regular routine work, relating to fog, atmospheric electricity, platinum thermometry, &c. A sum of £100 was obtained from the Government Grant Committee for the purpose of making experiments on the behaviour of platinum thermometers. These are found to possess advantages even in dealing with some ordinary temperatures which require to be read at a distance from the spot where they are recorded.

New Product of the Electric Furnace.—According to a note in *Nature*, M. Moissan is reported to have discovered a substance harder than the diamond, in the form of a compound of carbon and boron, produced by heating boracic acid and carbon in an electric furnace at a temperature of 5,000°. This compound is black, and not unlike graphite in appearance, and it appears likely to supersede diamonds for boring rocks, cutting glass, and other industrial purposes. It will even cut diamonds without difficulty, and can be produced of any required size.

Hysteresis.—At the Royal Institution to-night, Friday, May 22nd, Prof. Ewing will lecture on "Hysteresis." Messrs. Gabriel & Angenault will show samples of their duplex and other lamps.

The Sussmann Electric Miners' Lamp.—We have read the prospectus of the Sussmann Electric Miners' Lamp Company, Limited, and do not find that the advantages set forth differ from those of miners' lamps which have been before brought to our notice, both of the primary and secondary battery type but which have never been successfully and commercially introduced for a reason which, in our opinion, militates against the use of Sussmann's, or any other miners' electric lamp, viz., the price. The prospectus is discreetly silent as to the cost of the Sussmann lamp, but we are sure that the eminent firm who have contracted with the company to manufacture the article will allow no feelings of philanthropy towards the benighted miners to enter into their calculations, but will require an ample margin to cover their risks, so that it is probable that when the 5s. profit per lamp calculated on in the prospectus is added to the maker's contract price, together with the establishment and other charges, the cost to the miner of a lamp of the design, as illustrated in the prospectus, would not be less than £1. It is within our knowledge that an excellent miners' electric lamp, worked by a primary battery, with a cheap and effective electrolytic fluid, which was patented in Germany, America, and other countries, and combined all the good qualities claimed by the Sussmann lamp, but with a longer duration of light, was, within the last three years, offered to colliery proprietors at 15s. each, and refused, as the adoption would have involved too large a capital expenditure. Improved miners' safety lamps can be supplied by well-known manufacturers at about 5s. per lamp and less, so that until Government legislates and insists on the use of electric lamps, the majority of colliery owners will prefer their present lamp, and run the risks of explosions, rather than spend, say, £1,000 to equip a mine with the safer, but more expensive light. Where one enterprising proprietor exists, there are 10 who will prefer to go on working in darkness and danger. Therefore, until the parsimony and short-sighted policy of colliery owners can be overcome, we strongly advise the investing public to let miners' electric lamps, of any description, severely alone.

The London Tramway Scheme.—The following from Mr. M. Holroyd Smith comes too late for our "Correspondence" columns:—"The leading article in your last issue deals in an able manner with the question of tramway ownership and working. Much, of course, can be said for and against municipalisation; but the growing tendency of corporate bodies is becoming so pronounced, that without discussing the prudence or otherwise of the change, the change is sure to come. The article deals in a somewhat vague manner with the method to be adopted if electric traction is employed, and might convey to the public mind that you had doubts about underground conduits, this, with the knowledge you must possess of what has and what is about to be done, can hardly be the case. You know that I have for ten years or more advocated underground conduits for the busy thoroughfares of large towns and overhead conductors for suburban districts, and I am glad to find that this view is now becoming general. The same car can run over both systems, the change being readily made.—M. Holroyd Smith."

The Royal Society.—The following papers were down for reading yesterday afternoon:—"On the Changes produced in Magnetised Iron and Steels by cooling to the Temperature of Liquid Air," by Prof. J. Dewar, F.R.S., and Dr. J. A. Fleming, F.R.S.; "Helium and Argon. Part III.: Experiments which have yielded Negative Results," by Prof. Ramsay, F.R.S., and Dr. Collie; "On the Amount of Argon and Helium contained in the Gas from the Bath Springs," by Lord Rayleigh, Sec. R.S.

The Daily Press and Company Prospectus.—*Apropos* of the London Electric Omnibus Company, to which we refer elsewhere, the *Evening News* of Tuesday, in giving a notice of the company, says it has been formed to work the patents of Mr. John Imray. How proud we ought to be of the thorough manner in which our daily papers take prospectuses in hand for criticism. Mr. Imray is not the owner of the patents, he is only the valuer engaged by Mr. Radcliffe Ward to report upon them.

The Municipal Electrical Association.—The first annual convention of the Municipal Electrical Association will be held in London on Wednesday, Thursday, and Friday, the 10th, 11th, and 12th of the coming month, at the Royal United Service Institution, Whitehall, where the central meetings will be held. The first meeting is called for 10·15 on Wednesday morning, June 10th, when Mr. Arthur Wright will read his presidential address on "The Municipal Electrical Association and its Objects," and the following papers will be taken for discussion :—1. "Electricity Supply at 220 Volts," by A. S. Barnard, borough electrical engineer, Hull. 2. "Alternating Current Stations and High Voltage Lamps," by Harold W. Couzens, borough electrical engineer, Taunton. Papers numbered 1 and 2 will be discussed together. 3. "The Control by Municipal Authorities of Consuming Devices and the Wiring Connecting them to the Mains," by C. H. Wordingham, city electrical engineer, Manchester. 4. "Electricity Works Records," by A. B. Mountain, borough electrical engineer, Huddersfield. The meeting will adjourn at one o'clock, and in the afternoon various electrical works of interest will be visited. The second meeting will commence at 10.15 on the Thursday morning, when the following papers will be taken :—5. "The Cost of Electricity Supply," by Arthur Wright, borough electrical engineer, Brighton. 6. "Cable Specifications and Tests," by Joseph A. Jeckell, borough electrical engineer, South Shields. 7. "The Organisation of an Electricity Works Staff," by E. T. Ruthven-Murray, city electrical engineer, Worcester. At 1 o'clock the meeting will adjourn, and in the afternoon, at 3.30, the members, associates, and visitors will meet at the Vestry Hall. Mr. John Hesketh's paper on (8) "Electric Lighting and Traction" will then be taken, and a visit of inspection will afterwards be paid to the neighbouring electricity supply works in Eden Grove. The business meeting, for members and associates only, is convened for 10.15 on the Friday morning, when the president, vice-president, three members of committee, and officials for the ensuing 12 months will be elected, and the place of meeting for the 1897 convention decided upon. The meeting will adjourn at 12 o'clock, and, after luncheon, the Association will go down to Brighton by the 1.50 from Victoria or the 2.0 from London Bridge, arriving respectively at 3.15 and 3·20. At 4 o'clock they will be received by the Mayor, Mr. J. G. Blaker, at the Royal Pavilion, when the discussion will take place on :—9. "Extensions to Outlying Districts," by A. H. Gibbings, borough electrical engineer, Bradford. The inspection of the Corporation electricity works in North Road will afterwards terminate the business of the Convention.

Curious Occurrence in Northumberland Avenue.—Last Monday the insulation of one of the electric light cables laid in Northumberland Avenue was ignited, and numerous other wires laid in the same conduit were destroyed. The Fire Brigade were called, and after some difficulty put out the fire. Two or three electric light companies mains, Messenger Company, and Post Office wires are laid along this thoroughfare in a subway belonging to the County Council. It is said that the fire originated from an excess of current in one of the mains.

Lecture.—A lecture on "The Wiring Question" will be given on Wednesday, May 27th, at 8 o'clock, before the Electrical Trades Union, at the Club Union Buildings, Clerkenwell Road, E.C., when Mr. Fred Bathurst, A.I.E.E., of the Interior Conduit Company, will deliver an address on "The Wiring Question," with special reference to the present unsatisfactory condition of the wiring industry. Chairman, Mr. S. Rentell.

Proposed Canal.—It is proposed to construct a ship canal between Loch Gilp and Loch Crinan. At a point about a mile to the west of Cairnbaan there is said to be ample water power from the Knapdale Hills for the establishment of an electric installation, which would not only supply power to work the lock gates and swing bridges, but also light up the canal when required.

Gas Explosion.—A terrific explosion of gas occurred on 13th inst. in Tibbit Street, Bethnal Green. The entire front of a shop was blown out, the windows of the house next door were smashed, and an errand boy badly burnt.

Automatic Lubrication.—In treating of lubrication in "*Electrical Industries*," Mr. Foster reiterates the well worn truism that where the bearing is of a different material from the shaft, there is less friction, because the supposed interlocking of the particles is reduced. This fact, if it be a fact in practice, certainly lies at the root of the ordinary practice, which uses a gun-metal bearing for an iron or steel shaft; but it by no means follows that a mere laboratory fact continues into everyday practice. It is well known that where wrought-iron runs in a brass bearing, and has no end movement, the surfaces of both materials become badly fluted circumferentially. Replace the iron with cast-iron, and the fluting stops. As a fact, wrought-iron is a poor metal to run as a shaft without constant end movement, and cast-iron is infinitely superior, as was plainly proved on old-fashioned steam engines which had cast-iron crank shafts, and in cotton machinery, where the roller bearings of cards were sometimes thimbled with cast-iron with advantage. Again, rapidly revolving shafts, exposed to a good deal of vibration, as the spindles of the beaters in scutching machinery, were always made of cast-iron, and ran in cast-iron bearings. No one seems yet to have used the combination for dynamos, perhaps because of the increase of diameter due to the cast-iron thimble; but such bearings were run at 1,700 per minute, and kept practically cold, and it is worth noting that much shafting is now run in cast-iron bearings with satisfactory results. The advantage of cast-iron is that, being so much cheaper than gun-metal, bearings may be made three or four diameters in length, and not run into such a heavy expense as the same proportion of gun-metal would entail.

New Use for the Phonograph.—According to an American exchange, a remarkable experiment with the phonograph has been made in connection with a large pumping works on the Elk River, in California. The machinery, after several years, got out of order, and with a view to avoid, if possible, the great expense of having an expert sent so many thousands of miles to put the machinery into working order again, the manager tried an ingenious plan. He first spoke into the receiver, giving a full and general account of what he found to be the matter with the pumps; then he brought the receiver close to the machinery, so that the peculiar sounds of the pulsation of the defective pump might be recorded on the wax roll of the wonderful machine of Mr. Edison. The cylinder, on arrival at the office of the makers of the machinery in New York, by post, was placed in the machine, and the voice of the Californian was heard describing what he observed to be the symptoms of the diseased pump, and finally asking them to listen to the pump's action, which was imitated absolutely by the machine from the wax cylinder. The ingenuity of the manager was amply rewarded, for the curious experiment was a complete success. The wax roll enabled the experts in New York to diagnose the disease, the proper remedy was suggested, and the pump set running, so that the expense of sending a competent man from the Atlantic to the Pacific coast was saved.

Railway Train Lighting.—A Cape Town correspondent states that the experiment of lighting trains by means of a dynamo driven by an oil engine placed in a van has proved so successful on the Cape Government railways that the use of accumulators for through trains has been dispensed with.

Institution of Electrical Engineers.—On Thursday next, May 28th, a paper on "The Utilisation of Water Power, especially with a Small Fall, with some examples of Plants for the Generation of Electrical Energy," will be read by Alph Steiger.

The Tramway Scheme.—At last Tuesday's meeting of the County Council, the Highways Committee's report recommending the Council not to agree to the proposal of the Tramways Syndicate was again brought up and adjourned.

The Three-wire Patent.—The date fixed for the petition of Dr. Hopkinson and the Westinghouse Company for an extension of the three-wire patent, is Wednesday, July 15th, at 10.30 a.m.

Appointment Vacant.—The Lincoln Corporation invite applications for the appointment of electrical engineer at a salary of £300 per annum.

NEW COMPANIES REGISTERED.

R. H. Acquisition Syndicate, Limited (47,917).—This company was registered on May 14th with a capital of £5,000, in £50 shares, to carry on the business of mechanical engineers, gas, electric, and incandescent gas light manufacturers, electricians, machinists, fitters, millwrights, founders, wire drawers, tube makers, saddlers, metallurgists, electro-platers, &c. The subscribers (with one share each) are: W. T. Grant, 10, St. James's Place, S.W., gentleman; L. Wills, 29, Cornhill, E.C., gold miner; F. E. Croft, 29, Bury Street, St. James's, gentleman; W. T. R. Price, 33, Old Broad Street, E.C., solicitor; E. Baker, 29, Cornhill, E.C., gentleman; O. Thompson, 20, Bucklersbury, E.C., electrical engineer; C. W. Mayer, 29, Cornhill, E.C., manufacturer. Registered without articles of association by Morgan & Co., 33, Old Broad Street, E.C.

Direct Electric Generator (Foreign Patents) Syndicate, Limited (47,931).—This company was registered on May 14th with a capital of £100,000 in £1 shares, to adopt agreements with C. P. Shrewsbury, J. Cooper, F. L. Marshall, and J. L. Dobell, and to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity and electrical apparatus manufacturers. The subscribers (with one share each) are:—A. D. Seton, 36, Buckingham Terrace, Edinburgh, major; J. Lindsay, 39, Victoria Street, S.W., secretary; F. L. Marshall, 39, Victoria Street, S.W., gentleman; C. B. Shrewsbury, 8, Furnival's Inn, E.C., engineer; J. Cooper, 8, Furnival's Inn, E.C., gentleman; S. Spill, 24, St. Ann's Villas, Royal Crescent, W., gentleman; J. L. Dobell, 46, Connaught Road, Harlesden, electrical engineer. The number of directors is not to be less than three nor more than ten. The first are:—A. D. Seton, C. P. Shrewsbury, J. Cooper, F. L. Marshall, H. Dobbin, and S. Spill; qualification, £250; remuneration as the company may decide. Registered office, 39, Victoria Street, S.W.

Carbon (Foreign Patents) Syndicate, Limited (47,930).—This company was registered on May 14th with a capital of £100,000, in £1 shares, to adopt agreements with C. P. Shrewsbury, J. Cooper, F. L. Marshall, and J. L. Dobell, and to carry on the business of manufacturers of and dealers in carbon plates, slabs, rings, &c., for electric and electrolytical purposes, electricians, engineers, suppliers of electricity, &c. The subscribers (with one share each) are:—A. D. Seton, 36, Buckingham Terrace, Edinburgh, major; J. Lindsay, 39, Victoria Street, S.W., secretary; F. L. Marshall, 39, Victoria Street, S.W., gentleman; C. P. Shrewsbury, 8, Furnival's Inn, E.C., engineer; J. Cooper, 8, Furnival's Inn, E.C., gentleman; S. Spill, 24, St. Ann's Villas, Royal Crescent, W., gentleman; J. L. Dobell, 46, Connaught Road, N.W., electrical engineer. The number of directors is not to be less than three nor more than 10. The first are:—A. D. Seton, C. P. Shrewsbury, J. Cooper, F. L. Marshall, H. Dobbin, and S. Spill; qualification, £250; remuneration as the company may decide. Registered office, 39, Victoria Street, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Tramways Electrical Traction Company, Limited (43,132).—This company's statutory return was filed on May 9th. The capital is £172,500, divided into 15,000 £10 preference and 15,000 £1 10s. ordinary shares. All have been taken up, and £5 per share has been called on the preference, and the full amount on the ordinary. £97,500 has been paid.

Metropolitan Electric Supply Company, Limited (25,395).—This company's annual return was filed on April 23rd. The capital is £500,000 in £10 shares (of which 100 are founders'). All have been taken up, and 2,132 have been considered as paid; the full amount has been called on the rest, and £478,680 has been paid.

Rainbow Engineering Company, Limited (38,762).—This company's annual return was filed on April 10th. 1,931 shares have been taken up out of a capital of £20,000, in £5 shares. 1,500 have been considered as paid, and the full amount has been called on the others. £2,003 has been paid, and £152 is outstanding.

Dover Electricity Supply Company, Limited (39,778).—This company's annual return was filed on April 30th. 4,860 shares have been taken up out of a capital of £50,000, in £5 shares. £5 per share has been called. and £24,268 has been paid, leaving £32 in arrears.

Round's Accumulator Company, Limited (45,288).—This company's statutory return was filed on February 7th. Out of a capital of £10,000, in £1 shares, 6,040 have been taken up, and 6,000 are considered as paid; £1 per share has been called on 33, and 5s. per share on seven, and £34 15s. has been paid.

Rose & Bird, Limited (42,753).—This company's annual return was filed on May 7th. The whole capital of £3,000 in £1 shares has been taken up; 1,000 are considered as paid, and £2,000 has been received in respect of the remainder.

Willans & Robinson, Limited (40,660).—This company's annual return was filed on April 28th. The capital is £300,000, in £5 shares (of which 30,000 are £6 per cent. cumulative preference); 22,500 of each class have been taken up, and 14,463 preference and 14,462 ordinary have been considered as paid; £5 per share has been called on the rest, and £80,375 has been paid.

CITY NOTES.

The Sunderland Accounts.

We are glad to see that so much success is attending Mr. Vesey Brown's efforts at Sunderland, and it is still more gratifying to find that they are appreciated by the Corporation. Mr. Alderman Bruce, in proposing the adoption of the minutes of the Electric Lighting Committee at the last meeting, moved that on and after October 1st next the terms for the supply of electrical energy for lighting purposes be reduced by 1d. per Board of Trade unit, viz., from 6d. to 5d., with the same discounts as heretofore. He was glad to be able to say that the Committee recommended a reduction in the price of from 6d. to 5d. which, with the discount, brought the average down to about 4½d. per unit. He took that opportunity to go through the year's working. The sales of the current year had amounted to £2,040, rent of meters £126, and the balance from district rate was not £2,000, as was feared, but £701, which included an extra three months' interest of £220. To ascertain the cost to the rates for the past 12 months, they must deduct this £220 from £701, leaving only £480 as the cost for the year. When their engineer estimated that the output would be 80,000 units, he was laughed at, but the actual output had been 95,446, at an average price of 5·13d. per B.T.U., realising £2,040. Of course, his estimate for the next year would be increased, because they were going to lay down a larger plant. The committee did not recommend that the reduction should take place at once, because during the summer months few would use the electric light. Before autumn, however, the committee would have had time to carry out their extensions, and indeed arrangements were already made for the new building to be erected and the plant put in by September for the winter half-year. Already they had had word from many customers of their intention now that a reduction had taken place, of increasing their use of the electric light. He had pleasure in moving the report. Replying to an interpolation, he continued his speech by saying that the works had cost in current expenses £590, management £900, interest £829, and sinking fund £548. He doubted whether any private firm would have paid such a sum to the sinking fund when they had not been at work a year. In one sense there was not any loss on the electric lighting—the so-called loss was money taken from the rates and paid into the bank in order to defray the cost of the buildings, &c.

There were a good many pessimists in Sunderland when it was proposed that the Corporation should undertake the electric lighting of the town, but they have been doubtless converted to cheery optimism by this.

The Horseless Carriage Companies.

We have dealt with the London Electric Omnibus Company at considerable length in our leading columns, so that it is unnecessary to say much about it here. The capital is £250,000, divided into 250,000 shares of £1 each. The issue consists of 170,000 shares, payable 5s. on application, 5s. per share on allotment, and the balance as may be required in instalments of not exceeding 2s. 6d. per share, at intervals of not less than one month. The only name on the board which is familiar to electrical circles is that of Major Flood Page. The other directors are, no doubt, well known in their own circles, but it seems to us that the board might have been materially strengthened by one who had had practical experience of the working of London omnibus traffic. Mr. Charles E. Spagnoletti is the consulting electrical engineer, Mr. Radcliffe Ward is the engineer, and Mr. H. F. Lewis the manager.

The prospectus of the Great Horseless Carriage Company, though printed in the very largest type, is not easy to read. The capital of the company is £750,000 in 75,000 shares of £10 each. As the prospectus states in extra large type, that of the said capital now offered for subscription £250,000 is to be used as working capital, we may assume that half a million is to go to the vendors, and as this immense sum may be in shares or cash at the option of the said vendors, the probability is that the greater part will be cash.

The Great Horseless Carriage Company is full of enthusiasm. It says that throughout the length and breadth of the country buyers are now impatiently waiting to be supplied with carriages. It also says that the feverish rush and excitement attending the great railway

boom fifty years ago, when some of the greatest fortunes of the present day were founded, are now about to be repeated, which, to our way of thinking, is an unfortunate allusion. The Board is undoubtedly a strong one, and is made up of men experienced in almost all forms of road traction. The prospectus gives a list of over 70 patents which it controls, some of which, it may be mentioned, will expire in two or three years time. Among others we notice that several electrical patents of Mr. Bersey are owned by the company, as well as the various improvements effected in gearing by Mr. Worby Beaumont.

The Huddersfield Accounts.

The electric lighting works of the Corporation continue to make excellent progress. The excess of income over expenditure is £2,509, the receipts being £5,351 5s., and the total expenditure £2,842. Although the works are not yet independent of the rates, despite the fairly large profits, the deficiency on the year's work is being very satisfactorily reduced from year to year, and the following comparative statement will show to what extent reduction is being made :—

Comparative Annual Statement from the Commencement of the Undertaking.

Revenue Account.

Year ended	No. of consumers.	No. of 8-C.P. lamps connected.	B. T. units sold.	Income.	Expenditure.	Deficiency received from rates.	
						Amount.	Rate in £.
Dec. 31st, 1893 ..	112	9,613	43,224	£ s. d. 1,067 3 11	£ s. d. 3,614 11 8	£ 2,547	d. 1 5/16
Dec. 31st, 1 94 ..	214	15,342	156,169	3,560 8 7	5,625 13 4	2,065	1¼
Dec. 31st, 1895 ..	280	20,889	227,753	5,351 5 0	6,724 9 0	1,373	0⅞

The figures relating to cost of production are most excellent, and Mr. Mountain is to be heartily congratulated on the results he has obtained. It will be observed that there is a considerable loss on the system, the quantity of units not accounted for being 104,892, against 342,692 generated.

The following table gives the cost per unit :—

	1893.	1894.	1895.
Total capital expended ...	—	—	£49,079
Number of units sold	156,169	—	227,753
Quantity generated in B.T. units	—	—	342,692
Quantity unccounted for ...	—	—	104,892
Percentage loss	—	—	30·6
Number of lamps connected ...	9,613	15,342	20,889
Revenue from sale of current...	—	—	£5,055
Net revenue	—	—	£2,474
Average price obtained per unit	—	—	5·31d.

Cost of Production.	£ s. d.	Per unit.
Coal	542 0 0	·57d.
Oil, waste, water, and engine room stores	48 0 0	·05d.
Salaries and wages at generating station	687 0 0	·72d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	298 0 0 (Works' cost 1·65d.)	·31d.
Rates and taxes	329 0 0	·35d.
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	885 0 0	·93d.
Depreciation of buildings and plant account	—	—
Sinking fund account	—	—
Total	£2,842 0 0	2·93d.

Revenue.	£ s. d.	Average price obtained per unit.
By sale of current	5,055 0 0	5·31d.
Meter rents, &c.	218 0 0	—
Sale of lamps	78 0 0	—
Total	£5,351 0 0	5·31d.

Total cost per unit (exclusive of depreciation and renewal accounts), 2·93d.; works' cost, 1·65d.

The Gülcher (New) Electric Light and Power Co., Limited.

Mr. Chas. Fitch Kemp, the voluntary liquidator of this company, has issued his final report, and a meeting to receive the account of the liquidator will be held at 73, Lombard Street, at 12 o'clock, on May 26th, 1896.

West India and Panama Telegraph Company, Limited.

The ordinary general meeting was held on Wednesday at Winchester House, Mr. C. W. Earle presiding. The chairman referred with satisfaction to the turn which had now been taken in the long-continued decrease in their traffic receipts, there having been an improvement of £1,083, as compared with the receipts for the December half of 1894. It was quite true that that amount had almost been entirely wiped away by the loss of the French subsidy for Guadeloupe. This, however, they had foreseen, and it was a loss which they had no means of escaping from. Their traffic receipts, in view of the fact that they had about 5,000 miles of cable, and that they served 16 colonies, were almost ridiculous, the gross amount being about £2,500 a fortnight. Their company was a great and important enterprise, doing a good deal for the Government of the country, and holding together a great section of the Colonial Empire, and yet he found that it did not make nearly so much profit as that derived, for instance, by a certain little company which sold sweetmeats on the penny-in-the-slot principle! The expenditure was kept down to the lowest possible sum consistent with an effective service. They had put into the system less cable by 30 knots than they did in the corresponding period of the previous year, and this had caused a considerable diminution in the expenses under this heading—£2,831, compared with £5,876. They brought home the *Grappler* to take out a new supply of cable for stock. If they had not done this they would have had to charter a vessel out, and, therefore, they had charged this cable with a fair amount of the cost of the two voyages of their vessel. This had saved them about £2,000, but for which they would not have been able to pay the dividend now proposed of 6d. a share on the ordinary shares. Since the close of the half-year the St. Vincent subsidy had been reduced from £600 to £400 owing to the financial condition of the colony, which in former days had been one of the most liberal of the British colonies to the company. They remonstrated against the reduction, but it had been approved by the Secretary of State for the Colonies, and therefore he supposed they must bow to the decision. The chairman then concluded his remarks by referring to the proposed cable between Jamaica and Bermuda. The company was in correspondence with the Colonial Office on the subject, but they could not at the moment give details of this. After further remarks, the report and accounts were adopted.

A New Manufacturing Company.

We have received a printed report of a meeting of some of the principal shareholders of Woodhouse & Rawson United, Limited, held on April 20th, at the offices of Messrs. J. H. Duncan & Co., of 39, Coleman Street, E.C., in response to a circular sent out by Lieut.-Col. N. W. Wallace. The business of the meeting may be summed up in the following resolutions, which were unanimously passed :—

"That a limited company, with a capital of £50,000, should be formed to take over the Manchester works and the supply business of Woodhouse & Rawson United, a clause being inserted in the articles of association, whereby the company could only carry on industrial business."

"That the shareholders and creditors of Woodhouse & Rawson United have the right of applying, *pro rata*, for the first issue of £10,000 of such capital, with a minimum of £10."

"That a report of this meeting be sent to the shareholders and creditors, together with an application form showing the amount to which they are entitled."

The proposed name of the new company is "The Electrical Manufacturing Company, Limited (successors to Woodhouse & Rawson)," the directors being Col. Wallace, Mr. D. E. Cardinall, and Mr. W. Pirrie, with probably Mr. G. Stienthal as local director, and Mr. Bertram Thomas as manager.

County of London and Brush Provincial Electric Lighting Company, Limited.—Allotment letters and letters of regret, in respect of the second issue of 10,000 6 per cent. preference shares, have been posted.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending May 17th, 1896, were £864; week ending May 19th, 1895, £905; decrease, £41; total receipts for half-year, 1896, £18,800; corresponding period, 1895, £18,720; increase, £80.

The Liverpool Overhead Railway Company. The receipts for the week ending May 17th, 1896, amounted to £1,125; corresponding week last year, £1,141; decrease, £16.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending May 15th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,375.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, May 13th.	Closing Quotation May 20th.	Business done during week ended May 20th, 1896. Highest.	Lowest
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	10 — 11	10 — 11	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	49 — 51	48 — 50	49⅝	49
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	91¼— 92½	91½— 92½	92¼	91½
2,993,560£	Do. do. Defd.	Stock	...	...	...	9½— 9⅝	9½— 9⅝	...	...
130,000	Brasilian Submarine Teleg., Ltd.	10	6¼% §	7 %	...	14⅜— 15¼	14⅜— 15¼	15¼	15⅛
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	113 —117	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	...	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	160 —170	160 —170	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½%	...	⅞— 1	⅞— 1	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12 — 13	12 — 13	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20 — 21	19½— 20½	20¼	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	106 —109 %	106 —109 %	...	...
60,710	Direct United States Cable, Ltd.	20	2½% §	2 %	...	9½— 10	9½— 10	...	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6¼% §	6¼%	...	17 — 17½	17 — 17½	17⅜	17 3/16
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	...	18 — 18½	18 — 18½	...	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	106 —109	106 —109	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	130 —133	130 —133	131	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	18 — 18½	17⅜— 18⅛	18 1/16	17⅜
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	101 —105	101 —105	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	102 —105	102 —105	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	131 —134	131 —134	133⅜	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	101 —105	101 —105	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	102 —105	102 —105	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	105 —108	105 —108	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	110 —113 %	110 —113% xd	112	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅜% §	4½%	...	10½— 11	10½— 11	10⅜	10 9/16
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	...	17 — 17½	17 — 17½	17⅜	17⅛
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	8⅜%	10 %	23 — 24	23 — 24	24¼	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	54 — 57	52 — 55	53	...
100,000£	London Platino-Brasilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5⅛%	7⅜ — 8	7⅜ — 7⅝	7⅞	7⅞
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 18	16 — 18	17⅜	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	16½ — 17½	16½ — 17½	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6⅜ — 7	6⅝ — 6⅞	6 1/16	6⅝
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	107 —110	107 —110	109⅝	107½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4½%	5 %	9/16 — 11/16	9/16 — 11/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	108 — 111	108 — 111	...	...
11,839	Reuter's Ltd.	8	0 %	*nil*	...	6 — 7	6 — 7	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	133 —138	135 —140	139½	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	...	3½— 4	3½ - 4	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	97 —102	98 —103	100½	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	...	6 — 7	6 — 7	...	...
238,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	102 —105	102 —105	...	...
30,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	...	1 — 2	1 — 2	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	97 — 102	97 —102	...	...
64,248	Western and Brasilian Teleg., Ltd.	15	2½%	3 %	3 %	9¼— 9⅜	9¼— 9⅜	9⅜	9¼
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6⅝— 7¼	6⅝— 7¼	7⅛	6⅝
33,129	Do. do. do. Def. Ord.	7½	...	1 %	1 %	2½— 3	2½— 3	...	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	104 —108	104 —108	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	104 —108	104 —108	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅞%	⅞%	⅞%	1⅛— 1⅜	1⅛— 1⅜	1⅛	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11⅛— 11⅜	11⅛— 11⅜	11⅜	11⅛
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9½— 10½	9½— 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	108 —111	108 —111	110⅜	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	110 —115	110 —115 xd	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	102 —105	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	8 — 8½	8 — 8½	8½	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	7½— 8	7½— 8	7⅞	7 13/16
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4 %	116 —119	116 —119	116½	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	14½— 15½	14½— 15½	15½	14⅜
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½— 17	16½— 17	16 1/16	16½
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	134 —138	134 —138	...	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	*nil*	8 — 9	8½— 9½	9 1/16	8½
10,000	Do. do. do. 6% Pref., £8 pd., 40,001—50,000	10	...	...	6 %	12½— 13½	12½— 13½	13	12¾
50,000	†Liverpool Electric Supply, all paid	5	5 %	5⅛%	6 %	8 — 8½	8 — 8½	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2½%	3 %	4 %	14 — 15	14 — 15	14 13/16	14½
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	120 —123	120 —123	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	9 — 9½	9 — 9½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	10½— 10⅝	10½— 11	10⅝	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	4 %	5 %	7 %	9½— 10	9½— 10	9⅞	9½

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, May 13th.	Closing Quotation, May 20th.	Business done during week ended May 20th, 1896. Highest.	Lowest
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	3	5 %	2½%	...	1½ — 1⅝	1½ — 1⅝	1 5/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	3 %	...	1⅝ — 1⅞	1⅝ — 1⅞	...	...
125,000	Do. do. 4½ % Perp. Deb. Stock.	Stock	4½%	4½%	...	111 —114	111 —114	...	...
630,000	City and South London Railway	Stock	1½%	1½%	1 5/16 %	41 — 43	42 — 44	43	42½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 %	*nil*	...	2 — 2½	2 — 2½	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	...	1½ — 1⅝	1½ — 1⅝	...	...
17,139	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	...	2½ — 3½	2½ — 3½	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	...	104 —107	104 —107	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	...	1½ — 1⅝	1½ — 1⅝	1½	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	...	2½ — 3	2½ — 3	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000 ...	2	*nil*	*nil*	...	⅜ — ⅞	⅜ — ⅞	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅜ — ⅞	½ — ⅞	...	...
9,600	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	*nil*	...	9½ — 10½	9½ — 10½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	16½ — 17½	16 — 17	...	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	16½ — 17½	17 — 18	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	109 —114	109 —114	113⅜	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	23½ — 24½	23½ — 24½	24⅛	23¼
200,000	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	... ...	... ...	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2⅝%	14½ — 14½	14 — 14½	14	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	17 — 17½	17½ — 17⅝	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	38 — 41	38 — 41	39⅞	39
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	10	...	...	...	8¼ — 8⅜	8¼ — 8⅜	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7½%; 1890—5%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 6—6½.

Electric Construction Corporation, 6 % Debentures, 102—106.

House-to-House Company (£5 paid), 3⅜—4¼.

Do. do. 7 % Preference, of £5, 8½—9⅜.

Do. do. 4½% Debentures of £100, 110—112.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 9—9½; 1st Preference Cumulative 6 %, £5 (fully paid), 7⅞—8¼.

Liverpool Electric Supply, £5 (fully paid), 7⅞—8¼.

London Electric Supply Corporation, £5 Ordinary, ⅜—1¼.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7¼—8.

Bank rate of discount 2 per cent. (February 22nd, 1894).

THE INTERNATIONAL TELEGRAPH CONFERENCE OF 1896.

In the Electrical Review for May 1st, 1896, we published a letter from Mr. W. H. Mole, and we promised to deal in a future issue with his enclosure, a circular written in the French language, printed in Switzerland, and signed by "F. Gd."

Restricted space compels us to summarise the preliminary remarks of our Swiss friend, who comments exhaustively on the generally-recognised necessity of unification of International Telegraph Rates, and simplification of International Accounts.

"F. Gd.," points out the striking dissimilarity between the circumstances respectively governing the working of postal and of telegraph services. In the case of the former, extra distance involves no great extra cost, as carriage, whether by rail or by mail boat, is often practically gratuitous. For the latter, on the other hand, extra distance entails a vast increase in expenditure and costly plant, especially where submarine cables are concerned. The writer also emphasises the serious obstacle which hitherto has always opposed itself to the realisation of an unified European tariff, namely, the all but impossible task of satisfying the financial requirements of each Administration, without favouring certain States to the detriment of others.

It is stated that the first move in this direction was made at the International Telegraph Conference of Paris in 1890, when Germany submitted the following proposals :—

1. To make a universal charge of 12½ centimes per word between adjacent countries, and 20 centimes per word between countries non-adjacent.

2. To credit any adjacent or frontier Administration with 50 c. on each telegram traversing its territory, or going beyond.

The International Telegraph Bureau, after having been called upon to enquire into the German project, reported favourably on it, but suggested certain modifications. The most important of these was to increase the charge between non-adjacent countries from 20 c. to 25 c. per word, and the transit rate, under similar conditions, from 50 c. to 1 fr.

"F. Gd." proceeds to comment on these proposals, and subsequently elaborates an interesting plan of his own. We translate his words *in extenso* as follows :—

Generally considered, these proposals—apart from their main object—appear to tend towards a gradual suppression of transit charges, and, in emitting them, it would seem that the German Administration has drawn its inspiration from the principles prevailing in the Postal Service.

What leads me to suppose this is that the Bureau in question substitutes for the charge per word usually adopted in telegraphy, a tax per telegram which reminds one—vaguely 'tis true—of the charge per kilogramme on postal transit; but, as I have already pointed out, the telegraph forwards messages word for word, and this is the one salient fact which ought to serve as basis for calculating the cost, and the actual monetary worth of the work of transmission; also the system of mixed taxation adopted by the German Bureau will not tend to simplify international accounts.

The suppression of the transit tax would, in itself, constitute a distinct advance in the direction of uniformity and simplification of tariffs; but, as will be shown further on, the loss resulting from this suppression ought to meet with some higher compensation than that given by the German project. Then, again, closer study of the proposed reform shows that even the efficient steering of the German pilot has not succeeded in rounding the promontory—in overcoming the difficulty above mentioned. The German plan, in fact, accentuates the difficulty by increasing, whether between adjacent or between non-adjacent countries, the inequality already existing in the tariffs of the great and of the small States, an inequality wholly in favour of the lesser States.

Thus Luxembourg, which has no telegraph lines longer than 80 to 100 kilometres [50 to 62 statute miles], would

receive for forwarding a telegram over its lines the same remuneration as that levied by Germany for a like work, but over a line more than 1,200 kilometres long [750 statute miles], the construction and maintenance of which has, and will, cost 10 times more than that of the short Luxembourg line.* This inequality becomes all the more striking when one considers that the German proposals suppress the levying of a terminal tax at destination, and that consequently the tax of 12½ centimes really represents the cost of two transmissions.

Furthermore, this inequality is increased by the fact that the result of the German proposals, if we are not mistaken, would be to lower, in one respect, the terminal charges of the larger countries, and, in another, to increase those of the smaller. Countries of large extent suffer in this matter a loss of revenue all the more serious, seeing that this reduction applies also to the charges levied by them on traffic with non-adjacent States. In regard also to this tax, one must bear in mind that the German project encumbers it with a transit allowance of 50 centimes per telegram, which the collecting State has to make over to its neighbour. For this last mentioned, the allowance of which there is question does not constitute net profit, as it has in some cases (such, for instance, as in traffic between Russia and Spain or Portugal) to effect transit without any remuneration, for the reason that the third and fourth States, through whose lines a telegram has to pass before reaching the country of destination, are, by the German proposals, condemned to lend a merely gratuitous assistance.

Such an arrangement would be especially prejudicial to the submarine cable companies, for whom the transit tax constitutes a very important element of income. There are grounds also for inquiring whether it would constitute a just indemnity for the time and labour expended, for instance, in the transmitting of a telegram of from 30 to 100 words, let alone long press despatches.

It is true that the German project grants to countries of large extent, and to those whose telegraphic system is difficult to maintain, the liberty of levying a surtax of 10 centimes. This concession would somewhat lessen, for the States in question, the serious losses which otherwise they would probably experience, but it would finally result in sacrificing every chance of securing that uniformity in rates which is the primary object of all our efforts.

As we have already seen by what precedes, the German project, like most radical measures, will make several victims, and as it touches them in their most vulnerable spot, their finances, it will not be with perfect resignation that the victims will submit themselves to the sacrifice imposed on them. All do not have it in their power to imitate the disinterestedness of the German Bureau, the interests of which would, none the less, be injured.

It still remains for us to speak of the conclusions arrived at by the International Bureau, but as these do not dispose of the serious defects in the German proposals, discussion would be but a repetition of the arguments above enumerated. Would it be really impossible to solve the problem in a manner equally satisfactory to the great and little States, and to effect at the same time—in the manner of the German project—a decided simplification in international accounts?

Although but little acquainted with administrative affairs, still less with the unattractive branch of tariffs, the question of the unification of telegraph rates is one which greatly interests me, and a study of it has inspired me with a plan, which I venture to sketch.

The means which I here indicate are not wholly new, the Austrian Administration having already made, if I mistake not, the organisation of a common purse the subject of a proposal, either at the International Congress of Rome, or at that held at St. Petersburg.

The plan is as follows:—

1. The rate on messages exchanged between European States to be a uniform one of 22½ centimes per word.

2. Throughout Europe an extra tax of 30 centimes per word to be laid on all messages exchanged with extra-European countries.

3. No terminal tax to be levied, and no transit tax to be allowed over landlines, excepting under conditions specified in Article 5.

4. Monies emanating from rates levied under articles 1 and 2 to be put into a common fund, a special Central Bureau of International accounts to effect a division of the sum total of these charges as follows:—

(*a*) A deduction to be made on "1" of 2½ centimes and on "2" of 5 centimes, this to be devoted to an allowance for transit of telegrams through cables of administrations and companies controlling the European submarine lines.

(*b*) For the division and distribution of the remaining monies—equivalent to 20 centimes and 25 centimes per word, under articles "1" and "2" respectively—all European States to be divided and classified according to the extent of their telegraphic system, into four groups, as follows:—

1. Russia and Turkey.

2. Germany, Austria-Hungary, Spain, France, Great Britain, Italy.

3. Belgium, Bulgaria, Denmark, Greece, Norway, Low Countries, Portugal, Roumania, Servia, Sweden and Switzerland.

4. Bosnia, Herzegovina, Luxembourg and Montenegro.

Deductions in favour of the various administrations would then be effected on the following plan.

(*aa*) The first group would receive, for its own traffic, 20 and 25 centimes per word (respectively under articles "1" and "2"), plus an allowance of 2 centimes per word on the traffic of the states belonging to the second group.

(*bb*) Countries on the second group would make deductions from their receipts in accordance with *aa*, but, as a set off, would be entitled to receive an allowance of 2 and 4 centimes (respectively under articles "1" and "2") on the receipts of the countries in the 3rd and 4th groups.

(*cc*) It thus follows that the States on the 3rd and 4th groups would receive per word for their traffic, the former 18 and 23 centimes (respectively under articles "1" and "2"), the latter 16 and 21 centimes (respectively under "1" and "2").

(*dd*) The total amount derived from deductions of 2½ and 5 centimes per word apportioned for transit of telegrams by the European submarine cables would be divided among these lines in the following proportions* :—

	Km.	Km.	N.M.	N.M.	
1st group:	Cables from 500	to 1,000,	*i.e.*, 270	to 539,	25 centimes per word.
2nd group:	Cables from 250	to 500,	*i.e.*, 135	to 270,	20 centimes per word.
3rd group:	Cables from 100	to 250,	*i.e.*, 54	to 135,	15 centimes per word.
4th group:	Cables from 50	to 100,	*i.e.*, 27	to 54,	10 centimes per word.
5th group:	Cables from 1	to 50,	*i.e.*, 0·54	to 27,	5 centimes per word.

5. Countries whose frontiers or shores serve as points of departure or landing for extra-European land-lines or submarine cables will be authorised to levy on telegrams arriving from extra-European states a transit tax of 15 centimes per word, which will remain their own.

The adjusting of accounts relating to extra-European traffic, also to be effected through the medium of the Central Bureau for International Accounts. This system would not only have the effect of lessening, in great measure, the inequality of which mention has been made, but, like the German plan, it possesses the advantage of greatly simplifying the international tariffs; the more so, that it aims at a really uniform international rate.

It supplies also a means for suppressing transit accounts, and for the introduction of a uniform rate for extra-European traffic, as far, at least, as European lines are concerned.

I have not at my disposal the statistics necessary for an arithmetical proof of the possibilities and advantages of this system; but the results of my calculations, effected on the basis of the six examples, given in *L'étude du Bureau International*, on the proposal by the German Administration, are distinctly more satisfactory than are the corresponding data resulting from the German plan.

* This is why, in view of the prevision for the levying of a uniform charge, special arrangements are in force between several co-adjacent countries, which stipulate, we believe, that in cases analogous to the one we have taken as example, the smaller State must credit the larger with a part of the charge falling to her share.

* At an average rate of 15 centimes per word.

Amongst the staffs of the various Administrations, officials may, perhaps, be found to whom my idea may prove of interest, and who may feel disposed to subject it to serious inquiry.

(Signed) F. Gd.

PROCEEDINGS OF SOCIETIES.

The Institution of Electrical Engineers.

ON RAILWAY TELEGRAPHS, WITH SPECIAL REFERENCE TO RECENT IMPROVEMENTS. By W. LANGDON, member. (Paper read April 30th, 1896.)

(*Concluded from page* 643.)

BLOCK SIGNALLING INSTRUMENTS.

The practice of arranging the block signalling instruments apart from the signal frame has with most companies been abandoned. As a rule, all block apparatus is now fixed on a shelf immediately over the signal frame, so that they may be readily manipulated by the signalman, and their indications remain present to his view.

With the exception of the introduction of Tyer's tablet block, and Messrs. Webb and Thompson's electric staff for working single lines, there is little of novelty in block instruments to record.

Interlocking the electric with the mechanical signals has made but little progress. The mileage of railway lines in Great Britain* worked under the absolute block is 26,398. A very small fraction of this has the electric signals interlocked with the mechanical signals.

It appears almost marvellous that the enormous traffic which now passes over our railways should be conducted with so few casualties under an arrangement which entails a perfectly independent action for both the electric and the mechanical signals. The former are provided for the regulation of the traffic between signal post and signal post; but where they are not interlocked with the mechanical signals, which are those which actually guide the engine driver, they merely indicate to the signalman how he is to work his signals; they in no way control them! That so few casualties arise testifies in the highest degree to the care and watchfulness exercised by the signalmen to whom falls the duty of working the traffic under such conditions. The subject is one which may well lay claim to further consideration at the hands of some member of this Institution. In the meanwhile, it may be desirable to point out that the interlocking which has, so far, been employed, is still wanting in finality. As now used, it is the first vehicle which releases the lock. Needless to say, it should be the last.

Electric "signal repeaters" and "light indicators" have become indispensable adjuncts. On the Midland there are no less than 3,000 of the former, and some 800 of the latter in use, and with many other companies the number is, no doubt, as large.

Another useful adjunct is that termed the "repeater disc," employed to indicate the movement of the lever of "slotted" signals. It differs from the signal repeater in that the indicator, when passing from the ON to the OFF indication, directs the signalman's attention to the alteration by ringing a bell. (Fig. 14.)

"Light indicators" should be so constructed that they may indicate any failure in the light by a continuous ringing of the bell. This entails the maintenance of the *Light In* signal by permanent current. Two No. 1 *Leclanchés* work the instrument perfectly well. Fig. 15 is a diagram of the connections.

Fig. 16 is a diagram of the signal repeater arrangement, the batteries being placed at the signal post. The ON contact, B, is fixed, and the contact which the tongue piece, A, makes with it, is only sufficient to admit of a movement of 2 degrees. The contact, C, is adjustable. Samples are on the table.

* EXTRACT FROM BOARD OF TRADE RETURNS, YEAR ENDING DECEMBER 31ST, 1894.

	Total length of railway open for passenger traffic.		Distance worked by absolute block.			
				Distance of single line.		
	Double.	Single.	Double line.	Worked by train staff system in addition.	Worked without the train staff system.	Worked on electrical train staff or tablet system.
England and Wales	M. CH. 9,281·49	M. CH. 4,376·55	M. CH. 9,266·69	M. CH. 2,263·18	M. CH. 42·39	M. CH. 1,680·66
Scotland	1,289·09	1,761·00	1,287·19	222·04	119·43	961·61
Total for Great Britain.. ..	10,570·58	6,137·55	10,554·08	2,485·22	162·02	2,642·47
Ireland	613·00	2,414·52	613·00	451·09	0·70	1,555·51
Total	11,188·58	8,552·27	11,167·08	2,936·31	162·72	4,198·18

BATTERIES.

To the bichromate and Leclanché batteries the author ascribes the palm of merit for good and useful batteries for railway purposes. For hard and constant work the former is unsurpassed. For occasional purposes, and for constant action, under certain limitations, the Leclanché commands attention. The old form of Daniell (sulphate of copper) battery, it is assumed, no longer finds a profitable field in railway telegraph work.

The Leclanché-Barbier cell is the latest development of the liquid Leclanché type of battery. It differs from the preceding types in the form of the positive element, together with other mechanical details. The positive element consists of a hollow cylindrical agglomerate of carbon and peroxide of manganese, around the upper part of which is cast a metal ring, caused to fit the neck of the jar, between which and the metal ring an India-rubber washer is inserted. The centre of the cylinder is covered by a wooden block, which serves to support the zinc and to close the jar. There is thus little possibility of evaporation; the cell is practically hermetically closed, and is in every way satisfactory.

The most recent innovation in batteries is the so-called "dry cell," but of them the author cannot profess to any lengthened experience. In their early days they were frequently disappointing and unreliable. Much of that has now been remedied; yet, it is doubtful if

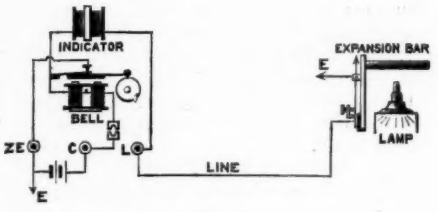


FIG. 15.

their employment on railways would be economical, for it would still be necessary to retain linemen and battery men, or assistant linemen, to attend to failures of instruments, &c., when such arose. General freedom from such failures would in no way modify this demand for the presence of the linemen. Failure at some time would be certain to arise. Whenever it did, the lineman must be there promptly to attend to it, or the traffic would necessarily suffer.

I feel that, in submitting to your consideration so lengthy a paper, I have largely encroached upon your time and patience. It has, however, been impossible for me to deal with the subject in less space, and equally impossible to divide it into two parts. I believe that you will, under these circumstances, generously accord me your

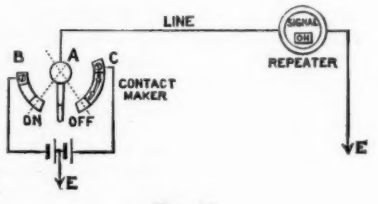


FIG. 16.

kind indulgence. As it is, I fear I may still have omitted some points of interest; and that, possibly, a want of knowledge of that which has been, or is being, done by others may even now render my treatment of the subject incomplete. Where such is the case, I must trust to my *confrères* to supply any such deficiency in the discussion which the paper may elicit.

APPENDIX.

POST OFFICE TABLES FOR COPPER TAPE BINDERS.

Weight of wire per mile.			Length of binder.	Copper tape.	
Line.	Approximate gauge.	Binder.		Length.	Width.
Lbs.		Lbs.	Inches.	Inches.	Inch.
800	4½	400	19	24	¼
600	6	400	19	24	¼
400	8	200	19	23	1/16
200	11½	150	17	22	1/32
150	12½	150	17	22	1/32
100	14	100	17	22	1/32

POST OFFICE TABLES FOR STRESSES TO BE OBSERVED IN ERECTING IRON WIRES AT VARIOUS TEMPERATURES.

Temperature in degrees Fahr.	Stresses in lbs. for various spans in yards.									
	200 lbs. per mile. (121 mils. diameter, No. 10½ S.W.G.)					400 lbs. per mile. (171 mils. diameter, No. 7½ S.W.G.)				
	50 yds.	60 yds.	70 yds.	80 yds.	90 yds.	50 yds.	60 yds.	70 yds.	80 yds.	90 yds.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
22	135	135	135	135	135	270	270	270	270	270
25	120	124	127	128	130	239	247	253	256	259
30	103	110	115	119	122	205	219	230	238	243
35	91	100	107	112	115	182	199	213	223	230
40	83	92	99	105	110	165	184	198	210	219
45	77	86	94	99	105	153	172	187	199	210
50	72	81	89	95	101	143	161	177	190	201
55	67	77	85	91	97	134	153	169	182	194
60	64	73	81	88	94	127	146	162	175	187
65	61	70	78	85	91	121	139	155	169	181
70	58	67	75	82	88	116	134	149	163	175
75	56	64	72	79	85	111	129	144	158	170
80	54	62	70	77	83	107	124	140	153	165
85	52	60	68	75	81	103	120	135	149	161
90	50	58	66	73	79	100	117	132	145	157
95	48	56	64	71	77	97	113	128	142	154
100	47	55	63	69	75	94	110	125	138	150
Poles per mile	35	29	25	22	19½	35	29	25	22	19½

Factor of safety of 4 at 22° Fahr. for all wires.

The stress varies with both the gauge and the material.

The stress for 100 lbs. (No. 14) copper wire is half that for 200 lbs., and the stress for 800 lbs. (No. 4½) copper wire is double that for 400 lbs.

POST OFFICE TABLES FOR STRESSES TO BE OBSERVED IN ERECTING COPPER WIRES AT VARIOUS TEMPERATURES.

Temperature in degrees Fahr.	Stresses in lbs. for various spans in yards.																				Temperature in degrees Fahr.
	150 lbs. per mile (97 mils. diameter, No. 12½ S.W.G.).					200 lbs. per mile (112 mils. diameter, No. 11½ S.W.G.).					400 lbs. per mile (158 mils. diameter, No. 8 S.W.G.).					600 lbs. per mile (193 mils. diameter, No. 6 S.W.G.).					
	50 yds.	60 yds.	70 yds.	80 yds.	90 yds.	50 yds.	60 yds.	70 yds.	80 yds.	90 yds.	50 yds.	60 yds.	70 yds.	80 yds.	90 yds.	50 yds.	60 yds.	70 yds.	80 yds.	90 yds.	
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
22	120	120	120	120	120	160	160	160	160	160	320	320	320	320	320	480	480	480	480	480	22
25	96	102	106	109	111	129	136	142	145	148	258	272	284	290	298	386	409	425	436	444	25
30	76	84	91	96	99	102	113	121	128	133	204	226	242	256	266	306	338	364	383	399	30
35	65	74	81	86	91	87	98	108	115	122	174	196	216	230	244	262	295	323	346	365	35
40	58	66	73	79	84	77	88	96	106	113	154	176	192	212	226	232	265	294	318	338	40
45	52	61	68	74	79	70	81	90	98	105	140	162	180	196	210	211	243	271	296	317	45
50	48	56	63	69	75	65	74	84	92	100	130	148	168	184	200	194	223	253	277	299	50
55	45	53	59	65	71	60	70	79	87	94	120	140	158	174	188	182	211	238	262	284	55
60	42	50	56	62	67	57	66	75	83	90	114	132	150	166	180	171	200	226	250	270	60
65	40	47	53	59	65	54	63	71	79	86	108	126	142	158	172	162	189	214	238	260	65
70	38	45	51	57	62	51	60	68	76	83	102	120	136	152	166	153	181	205	229	249	70
75	37	43	49	55	60	49	58	66	73	80	98	116	132	146	160	147	173	197	220	240	75
80	35	41	47	53	58	47	55	63	71	77	94	110	126	142	154	141	166	190	212	232	80
85	34	40	46	51	56	45	53	63	68	75	90	106	122	136	150	136	160	183	205	225	85
90	33	39	44	49	54	44	52	59	66	73	88	104	118	132	146	131	155	177	199	218	90
95	32	37	43	48	53	42	50	57	64	71	84	100	114	128	142	127	150	172	191	212	95
100	31	36	42	47	52	41	48	56	62	69	82	96	112	124	138	123	146	167	188	207	100
Poles per mile	35	29	25	22	19½	35	29	25	22	19½	35	29	25	22	19½	35	29	25	22	19½	Poles per mile

AT the ordinary general meeting of the Institution, held at the Institution of Civil Engineers, Great George Street, Westminster, on Thursday evening, April 30th, the chair was occupied by the president, Dr. John Hopkinson, F.R.S.

The minutes having been read and confirmed, and the names of new candidates and transfers announced,

Mr. W. LANGDON read a paper on RAILWAY TELEGRAPHS, WITH SPECIAL REFERENCE TO RECENT IMPROVEMENTS.

Upon the conclusion of the reading of the paper, Mr. Langdon read letters which he had received from Mr. Graves, of the North Eastern Railway, and Mr. W. H. Preece, regarding his statement as to the first copper wire erected. Mr. Graves said the first copper wire he erected was in July, 1871, and not in 1877; this was put up between the Newcastle Station yard and the Gateshead yard on the south side of the Tyne. Copper wire had been used in a number of places on the North Eastern Railway before it was erected at York in 1877. Mr. Preece wrote that he thought the author was wrong in saying that Mr. Graves was the first to put up copper wire. All the wires first erected between Paddington and Slough were of copper. The great start in copper, however, was made by him (Mr. Preece), when he was induced by Mr. Patey to run up copper wire from London to Newcastle, this line proving that copper not only reduced resistance, but led to increased capacity, and eliminated electromagnetic inertia, and also increased the speed of working. The Post Office had also introduced copper wire for telephone circuits for the same purposes.

Mr. WYLES, in opening the discussion, said he was not prepared to discuss Mr. Langdon's paper with regard to telegraphic arrangements, because they generally accepted what was done on the Midland Railway as the best that could be done: that was well known among all railway telegraph engineers. But the question of interlocking had not been dealt with very fully, and Mr. Langdon almost invited another paper to be read on the subject at a later time. All the congested traffic out of London—at any rate on the southern side—was controlled electrically. On the South-Western, from Waterloo as far as Esher and Twickenham, everything was interlocked, and they were extending the system very largely. From Cannon Street to London Bridge, and a considerable way down the South-Eastern was interlocked, and the same thing prevailed on the Brighton line and the Great Eastern. On the South-Western especially, they were largely called upon to assist the mechanical department, by doing a lot of work electrically which could not be done mechanically. Electrical fouling bars were coming very much into use, and were put down by the telegraphic department; but they were always asked for by the mechanical department to assist them in their work, help the traffic, and secure greater safety. They had a good many cases where signals were thrown to danger electrically. Then with regard to single lines, they had an arrangement on the South-Western which was devised by Mr. Sykes, and in regard to which he (the speaker) had had a good deal to say, by which they could not lower the starting signal unless the tablet was withdrawn.

Mr. GOLDSTONE said he would ask Mr. Langdon to make a little correction in his paper; it was probably a printer's error. In speaking of duplex working, the paper alluded to the use of the system on the London and South-Western Railway. He thought that must mean the London and North-Western, for they had nothing of the kind on the South-Western service. He must also say that he was somewhat surprised to find that so little was being done generally throughout the Kingdom in connection with interlocking. On the South-Western they had at the present moment in use something like 150 miles of electrical interlocking. They had large orders in hand, and he apprehended that by the end of the year quite a third of the whole line would be interlocked, and certainly all the busy portion of it. As Mr. Wyles remarked, they were called upon to enable the train to throw up signals electrically as it passed them, and they were doing a good deal in the way of train describing; in fact, at no period in his experience had they been making greater progress than at this moment, principally in interlocking.

Mr. SPAGNOLETTI said the paper wanted carefully digesting before it could be discussed properly; but he must compliment Mr. Langdon for giving them so much information. He had no doubt that to the younger members of the Institution it was information which was entirely new. There were one or two points in the paper, however, that wanted a little discussion. For one thing, he rather took exception to the system of poles described, and shown in figs. 1 and 2. The H-pole system, as they called it, had now been in use for a considerable time, and he would suggest what he thought would be an improvement on Mr. Langdon's method of putting up H-poles. If they looked at the figures on the wall, they would notice that the side pieces of the poles were bolted through. If one of those poles were to sink, it would be hinged, as it were, on the other pole. It was true the iron cross-pieces would, to a certain extent, stop that, as also the cross-arms; but it would put a very heavy strain on the upper portion of the pole. His practice was, instead of having two cross pieces at the side, to put one at the bottom to give a bottom

bearing, which gave a much more substantial position to the pole, he generally put two cross-pieces of wood, bolted through, which made a stronger structure of it. Instead of the iron cross-pieces in fig. 2, there were no cross-pieces at all. If either pole were to sink, all the strain would be put on the cross-arms. If Mr. Langdon would look at that critically, perhaps he might find that an alteration for the better might be made in that respect. Then with regard to staying poles, that was a most important matter, and one that he took up very strongly, because they had such great difficulty in staying the poles properly, and he introduced the screw stay-rods to get out of the difficulty. It helped them out to a great extent, but he found after some years, that the heads of the bolts pulled through the blocks of wood, although the latter were creosoted. He substituted then what he called a stay-plate, an iron plate, where the rod went through the centre. The square head of the rod was prevented from turning by a flange each side of the hole, and being made of cast-iron, they lasted very well underground. The iron arms he had not done very much with, but they did not earth-wire the arms. On this staying question Mr. Langdon also spoke of the snow falling on the wires. The stays were, of course, of very great assistance in case of snowstorms. They had had as much as 30 or 40 miles of poles broken down, and the wires were twisted in a shocking manner. Snow attached itself to the wires and formed solid blocks of ice, and the action of the wind upon these caused the wires to break and the poles to run down for some distance. That had been got over by staying the poles in the direction of the wires as well as laterally. If they stayed the poles first one on the right side, and then another perhaps five poles away on the left side, that would stop the breaking down for more than five poles at any rate. With regard to insulation, Mr. Langdon stated that he had adopted on the Midland a system having one gauge of iron wire, No. 8, but seemed to show a preference for copper wire, and one class of insulator. That was a good thing to do, and he thought most lines used one class of insulator. But he (the speaker) did not see why, in open country, iron wire should not be used. Mr. Langdon, in speaking of copper wire, seemed to have a great preference for it. There was no doubt that for lightness and conductivity and long circuits it was an excellent wire to use; but on some of the country branch lines, where they had a pure atmosphere, they did not know the end of iron wires. He knew some that had been up for 35 years, and were still in very good condition; and iron wire was very much cheaper, as Mr. Langdon showed in the prices he gave. Copper wire, too, was very difficult to handle, and it wanted a very careful man to put it up. With regard to the terminal insulator, that was a very good insulator indeed. Its only fault was that, as against the old shackle, it was more liable to pull over, because of the strain at the top, and the fixture at the bottom. With the shackle this did not occur. This insulator made a very good system where they had to join wires of a different gauge together. But the shackle possessed the same advantage, the iron running up to the insulation, and he did not think there was any advantage over the shackle in sustaining the wire in case of the earthenware or porcelain getting broken. Leading in cups (fig. 6) were very excellent things, but they could not be considered quite a new introduction. Mr. Latimer Clarke introduced them a good many years ago. Then with regard to the shortness of life of iron wire, that entirely depended on the position where it was fixed. On the Great Western in South Wales it lasted about three years, in Birmingham four or five years, and in London six or seven years. The covering of the wire with West's compound was an excellent idea. They had found the best thing was to put wire in boiling tar, leaving it to boil for some time. If they warmed the wire and put it into the boiling tar, and then sanded it with fine sand from iron stone, it was coated with an enamel that was better than any other compound they had ever seen. There was some wire of that description put up between Wolverhampton and Worcester, and the iron beneath the enamel was as bright now as when it was put up 35 years ago, and was in excellent condition. It made a splendid preservative against atmospheric effects on the wire. The worst of copper wire was that it was liable to damage when being put up with the draw vice. It very often had to be painted over or tarred, in order to cover the places up that had been destroyed by the grip of the vice. Otherwise the strongest link in the chain became the weakest. As to the interlocking system, it had been adopted on the Metropolitan Railway from one end to the other for the last 10 or 12 years. They had a system also for shunting and protecting trains when on the wrong line, or crossing from one line to the other. With this system if a train coming on the up line had to cross to the down, whilst it was on the up line the up line was blocked; whilst it was crossing to the down line both were blocked, and when it was on the down line the up line was free and the down line was blocked, and they might pass trains as often as they liked without any danger at all. The next thing he wanted to say was with regard to the iron tubing, fig. 11. He used to have this, but found that very often workmen with their pickaxes would break the tubes and damage the wires; they found it was much better to put a thick oak or elm shuting, so that the workmen found their picks were into something before doing any damage. The phonopore telephone was being used on a great many railways; it gave them the opportunity of speaking on the telegraph wires whilst they were at work, and to hold a running conversation without any difficulty whatever. They could divide a long wire up into several circuits, and take a connection from the telegraph wire into the administrative offices, working the circuit as they liked, and using at the same time the telegraph and the telephone.

Mr. Charles Bright asked how it came about that it was the custom, as apparently it was, in railway telegraphs, to employ gutta percha for insulating underground conductors in preference to India-rubber; and why, in laying down G. P. lines, special pains seemed to be taken to avoid moisture? Unless the ozokerite tape in which they were enveloped was in any way damaged thereby, he (the speaker) did not understand it; for permanent moisture was, he believed, always looked upon as the most favourable condition possible for gutta percha. In a perfectly dry soil, however, the bulk of evidence as regards underground lines generally was, he thought, all in favour of India-rubber as the insulating medium, for here G. P. loses its essential oil by evaporation, rapidly cracks, and ultimately falls into powder. An outside covering of ozokerite tape can, at the best, only modify these unpropitious tendencies, and, in fact, render the whole more like an India-rubber insulated line. Where alternating dry and wet conditions prevail, the speaker has found gutta-percha and India-rubber to behave equally badly in the extreme instance of tropical climates. With India-rubber it is a case of chemical change and decay which, apparently, vulcanisation can only partially allay under the most favourable circumstances possible. With gutta-percha, the cracks that have been set up in the previous dry soil become rapidly filled with water under the changed conditions and then—well, good-bye to the insulation resistance. Probably the most efficient protection, under such conditions, is provided in the plan (which originated with Messrs. Clark, Forde and Taylor) of running G. P. covered wires through iron pipes kept filled with water. I. R. or G. P. insulated wires, hermetically sealed by a lead tubing (if the soil is not of a character which acts on the lead), are also very efficient, or even steel taping for ordinary underground purposes.

Mr. Von Fischer Treuenfeld said telegraph engineers ought to be very much obliged to Mr. Langdon for bringing this subject forward. He was pleased to see that at least one branch in telegraphy was not regarded as having reached finality, that of interlocking, and thought they would agree with him that not merely one, but a good many branches in telegraphy were still wanting in finality, and the general opinion which had prevailed in recent years was wrong, that the limit of the sphere of action of telegraphy had been reached, and that there was no further field for energy and intelligence to develop. They could suggest to the younger members of the electrical fraternity a splendid field for energy and development. With regard to the paper, there were one or two points he would like to mention. The author referred to Mr. Alexander Siemens in connection with iron poles, and, as Mr. Siemens was not present, he (the speaker) might, perhaps, be allowed to answer the questions in his stead. Iron telegraph poles have been very much and successfully employed, especially in the Colonies, in consequence of their greater stability and greater ease of transport over long distances. But there was a strange fact, which iron manufacturers could probably better explain than telegraph engineers, and that was, that iron telegraph poles of adopted dimensions would not stand the breaking strain nowadays that they would 25 years ago. This fact had led to the necessity of devising new methods of construction which would give the poles greater stability, and Mr. Siemens had succeeded in doing this, and had taken out a patent for a pole of very simple arrangement. The lower part was of cast-iron, and the upper portion of wrought-iron tubing. At first, the top part was cemented to the upper 6 or 9 inches of the lower tube; but it was only in later years found that these poles broke at the joints, and Mr. Siemens had constructed a pole in which the upper tube was not only fastened to the top of the lower tube, but went right down inside to the bottom of the conical shaped base tube. This gave a very solid pole, much stronger than the older form. If he might be allowed, he would like to say a word or two against the employment of copper wire. He was fully aware of all the advantages of copper over iron wire. The electrical capacity and the consequent increase of speed in working, which amounted to something like 30 per cent., was enough to give the preference to copper over iron. He had in mind the very poor breaking strain of copper wire. The electrical resistance, as compared with that of iron, rose very nearly inversely as its price per ton, so that if they had to replace iron at 12½ ohms. per mile by copper wire, they had to choose a No. 14 or No. 16 wire of 0·069 diameter. The breaking strain of the 7½ iron wire was about 1,300 lb., but that of the 14 copper was only 290 lb. If they adopted the rule that the tension of the span of the wire should not exceed a quarter of the actual breaking strain of that wire, there would be left a reserve breaking strain of 867 lb. for the iron wire, and only 193 lb. for the copper wire, to oppose any extra tension or load such as would be caused by the accumulation of snow on the pressure of wind. It came to this, that telegraph lines erected of copper wire during a snowfall combined with wind were much more likely to succumb than those constructed of iron wire. He would ask the experience of Mr. Langdon with regard to the breaking down of copper wires in snowstorms.

The President said it had long been an opprobrium to the Institution that they had no papers from railway telegraph engineers, but Mr. Langdon had certainly removed that opprobrium, and he believed at great inconvenience to himself.

Mr. Langdon, replying to the points raised in the discussion, said no doubt interlocking had progressed during the last three or four years to a considerable extent on the lines mentioned, but particularly on the South Western and Great Eastern. There was no doubt this interlocking was a most desirable thing; but it was to be regretted that in undertaking this matter the companies should not have dealt with it in a more final manner. As he stated in the paper, it was the first vehicle which gave relief to the block section. A train entering a section put on the starting signal automatically, and the block signals were put on by hand; those block signals controlled the mechanical signals, and they remained locked until the train passed out of the section. If a train happened to be divided, the second portion remained in the section, and if one vehicle passed over the redress point, that enabled the signalman to clear the train, and another train might then come in and cause a serious accident. Therefore the present system had no finality about it, and it would be well for the railway companies to

consider the matter further. Complete safety was only to be obtained by attaching to the last vehicle of the train something which should give the signal, "train out of section." If the train divided, that vehicle would remain on the line, and the signal would not be cleared. Mr. Wyles had mentioned that electricity was rendering considerable aid in what he termed the mechanical departments; that is to say, that it had taken the place of mechanical appliances. Mr. Treuenfeld also indicated that there was a larger field. That was undoubtedly so, and it was only necessary for railway engineers to associate themselves with other branches of the service to find out those places where it could be applied, and make use of it. Mr. Goldstone had corrected him with reference to duplex working on the South Western railway. He was not aware that he had made a mistake, but if he found it was the case, he would correct it. Mr. Spagnoletti took exception to the "H" pole system; he had probably forgotten the diagonal piece at the bottom, the object of which was to prevent that scissors motion which Mr. Spagnoletti thought would arise. There was nothing, of course, to prevent one pole sinking more than another. That was why in planting the second pole he allowed it to stand for a time before consolidating the structure by putting on the cross arms. The proof of the pudding was in the eating, and the point was that they had erected some hundred miles of those poles, and had not found one sink more than another. He did not think he was entitled to any credit in the matter, because he believed it had been done by other engineers before, although, perhaps, not to any great extent. Then Mr. Spagnoletti pointed out that the stay rods sometimes pulled out. He never knew them do so unless the blocks were rotten. In all stay rods there was a plate at the bottom of the block, and the head of the rod banked upon that plate; that ought to prevent it from going through, unless it was very rotten. [Mr. SPAGNOLETTI: I referred to rotten ones.] If they were creosoted, they ought not to rot. With reference to lateral staying, he had not mentioned it; but it was a practice pursued by him for many years. It had been the case that they had had a serious breakdown, and the wires ran back. The way to prevent that was to have lateral stays at every tenth pole, where the wires exceeded 20. Mr. Spagnoletti also mentioned his experience that iron wire lasted 35 years. He could only congratulate Mr. Spagnoletti on having such a locality; he wished he had such. Either the districts where his company's wires ran were more smoky, or their wire was very inferior. It had been said that there was a difficulty in the handling of copper wire. He had not experienced it; the men under his direction found no difficulty. They had to be careful not to pull it up too tight, but they had their tension tables, which showed them the amount of strain to put on the wire in pulling it up; they complied with that, and there was no difficulty whatever. There was no question that the shackle had a much more direct influence upon a wire than a terminal insulator. There was not the leverage about it, the strain came direct in the loop, but at the same time it was an inferior insulator. Mr. Spagnoletti might also be quite right with reference to leading-in cups, although he (the speaker) did not remember their being in use at the time mentioned. As to wire being steeped in boiling tar, it occurred to him the value of tar as a protective presided mainly in the oil it possessed, and when that oil evaporated under the influence of the sun, there was nothing but a sediment left, which would be a very poor protection for the wire. That was his experience. At the same time he must admit he had not heated wire and steeped it in boiling tar. With respect to the phonopore, his company had enjoyed its use to a limited extent, and if those who had the phonopore in their hands could only arrange it in such a manner that it would dispense with the induction they got from it, it would be an excellent instrument. The induction interfered with their telephones, and they got nothing but complaints. Mr. Charles Bright asked why gutta-percha was used for underground work rather than India-rubber. Gutta-percha had been used for a good many years. India-rubber, he had no doubt, was equally as good. It became more plastic when exposed to the air. If they could keep gutta-percha always in the water, undoubtedly that would be the best thing to do; but that was an impossibility, and if they had it sometimes dry and sometimes wet it soon became porous. It should be mentioned that there was not that demand for underground work on a railway that existed with road or street telegraphs. He should be prepared to try some India-rubber cables for tunnel work when the opportunity occurred. The ozokerite tape was the best protection to the G.P. wire when it had to be used in dry places. It delayed the evaporation of the oil. Mr. Treuenfeld called attention to iron poles. Iron poles had been tried, to a certain extent, on railways, but they were not large enough or strong enough for their purposes unless they went to great expense—such an expense as would be wasteful in comparison with creosoted poles. Then Mr. Treuenfeld objected to copper wire, as compared with iron wire, and he had strengthened his argument somewhat by reference to the accumulation of snow on wires. It was very strange, but he found very little difference between the amount of snow gathered by the iron wire and that gathered by the copper wire, although one might be much larger than the other. At all events, the experience they had was that copper wire stood just as well as the iron.

SAFETY TROLLEY WIRE SUPPORTS.

Mr. A. E. Hutchins, of Detroit, Mich., whose safety appliance for diverting dangerous current in the case of the breaking of a street circuit was described in the Electrical Review last December, is also the inventor of an automatic safety hanger for trolley and dangerous electric wires. The apparatus, which is shown in the illustrations, instantly removes and drops prostrate to the ground any part or section of a live wire or line that has been broken, and is hanging down in the way. Sometimes, when trolley wires have broken in the States, several blocks, or half a mile of trolley wire has been damaged or annealed through its dangling and touching the rail, not to take into account the loss of electric current and the strain and damage to the electric machinery at the power house. Mr. Hutchins claims that this will be avoided by simply supporting the trolley wire by its sectional form of ear or hanger.

Then, instead of a live wire hanging down from its trolley ear or support, the wire has been disengaged from the safety hanger, which at once stops the live current, by at once ejecting the impaired part of the line to the ground.

Then the momentum of an approaching car propels it past the vacant section of broken line, the wheels of the car merely passing over the dead length or piece of trolley wire (if it had not been previously removed by a passer by); so it is claimed that by using this invention there will be no danger to life, no dangling wire to frighten or to be run into, and the least of inconvenience to the traffic of the road. As soon as the repairer to the line arrives, he simply hooks in a new section of line, provided with a special form of quick repair ear clamps.

The safety trolley wire hanger has an inner space or recess with (4) inclined ledges which provide a seat for holding the enlarged and inclined heads or hooks of the terminals or ears that clasp on to the trolley-wire. Normally the pulling or strain of the suspended wire holds the wire (by its terminal ears) into the socket of hanger, but in case a wire breaks it all falls at once to the ground, a dead wire, by being ejected from contact of live part of the line at its safety support—gravity doing the rest.

The sectional view shows the safety hanger as supported by a strain insulator (double pull-off style) with pieces of span wire attached. It also shows the enlarged head of terminal ear in (dark) recess of safety hanger, which terminal is grooved at the bottom and holds the trolley wire. Under this is a quarter section of a trolley wheel, showing that its flanged part contacts with the sides or flanged part of safety hanger when passing adjacent sections of trolley wire of hanger.

The under view shows on one side twin ledges which are inner cut so that the strain of the wire on the hooks (also undercut) tends to hold the walls of the chamber together instead of its spreading apart. A spring is also shown operating to hasten the release of the wire. This safety hanger ejects only the broken section of trolley wire. The balance of the line remaining undisturbed through any commotion or sagging of the trolley wires due to swaying of the span wires.

THE EXHIBITION OF THE SOCIÉTÉ INTERNATIONALE DES ELECTRICIENS.

An exhibition of electricity, as applied to domestic, medical and scientific purposes, was held by the Société Internationale des Electriciens on the 2nd, 3rd and 4th inst. at Paris.

This exhibition may be divided into three very distinct parts, corresponding to the number of halls occupied. In the first part we find a collective exhibition of the sectors of Paris. A complete domestic installation was shown. A dining room, a drawing room, and a dressing room were arranged, provided with most elegant apparatus, which were fitted with incandescence lamps. A special corner was reserved for the electrical cooking apparatus, where a cook broiled chops and steaks on electric grills and radiators. Water was also heated in a boiler.

The second section was devoted to medical apparatus. Here we find various electro-medical apparatus constructed by M. Caiffe. Dr. Foveun, of Courmelles, installed several mural rheostatic boards for the currents used in the town, pyro-galvanic instruments and electrodes for various medical purposes. The rest of the room was occupied by M. Bonetti, who exhibits a static machine with a large output, giving a spark 30 centimetres long, various Wimshurst machines, and supports for electric shower-baths. The firm of Ducretet & Lejeune showed various experiments on the Röntgen

rays with fluorescent screens, photographs obtained with these rays of real and imitation diamonds, registering galvanometers, an ohmmeter, a connecter and disconnecter, &c. M. Radiguet has also made a great many experiments on the Röntgen rays, and he showed various models, and also a little electric installation with batteries.

The large hall contained a number of clusters of lights beautifully arranged and fitted with incandescence lamps, and Cance, Brienne, and Pardon arc lamps. All these lamps were lighted all day. Among the various exhibits we may mention the installation of the firm of Beau & Bertrand-Taillet, the measuring instruments, voltmeters, and amperemeters sent by the firm of Arnoux & Chauvin, the first incandescence lamp manufactured by the Edison Company at Ivry, in 1882, a new model of the Brillié meter, the apparatus, interrupter, circuit-breaker, and boards constructed by the old Clémançon establishments, the Carpentier melotripe (?) with a new type of induction coil, the Cance apparatus, rheostats, and boards, the Richard and Mildé apparatus. The Meter Company showed several Thomson meters at work, and we noticed a special bipolar disconnecter, which acts as soon as a short circuit is produced, and the object of which is to limit to a certain value the intensity that would result from short-circuiting in an installation. We may also mention the Déjardin meters, the Frédureau globes, the Genteur interrupters and circuit-breakers, the low power motors of the Doignon firm working a sewing machine and a lathe. The Société Industrielle des Téléphones works the Courval arc lamp, three in series at 110 volts with alternating currents.

In a little room near the first, were placed Blot, Jarriant, and Tudor accumulators. Here also were to be found the Blondeau continuous and polyphased current motors, and also the boards used for the course of lectures on industrial electricity given by M. Laffargue at the Union of Stokers and Mechanics since 1890.

This exhibition attracted a large number of visitors; the main object of it was to show that electricity could be adapted to many purposes by simple and rapid manipulation. All the installations were fed by the current, and the lighting of all the halls was splendid.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 322, *High Holborn, London, W.C., to whom all inquiries should be addressed.*]

NEW PATENTS.—1896.

20,542a. "Improvements in or connected with apparatus for the electrolytic decomposition of liquids." G. Bell and G. W. Bell. Dated May 4th, 1896. (Date claimed under Patents Rule 19, October 31st, 1895.)

9,402. "Improvement in electric gas lighting devices." O. Von Morstein. Dated May 4th.

9,447. "Improved reversible variable speed gear applicable for use in electrical regulation and other purposes." A. G. Cooke. Dated May 4th.

9,480. "Improvements in electrical contacting devices for subways or conduits." A. S. Krotz, W. P. Allen and O. S. Kelly. Dated May 5th.

9,517. "Improvements in electric locking and block signalling on railways." W. R. Sykes and F. T. Hollins. Dated May 5th.

9,528. "Improvements in telegraphic relays and the like." H. H. Lake. (C. G. Burke, United States.) Dated May 5th.

9,530. "Improvements in sockets or holders for incandescent electric lamps." J. Devonshire. (H. C. Wirt, United States.) Dated May 5th.

9,531. "Improvements in dynamo-electric machines." J. Devonshire. (C. P. Steinmetz, United States.) Dated May 5th.

9,534. "Improvements in electric switches for use with or without mechanical or electro-magnetic brakes." J. Lavender. Dated May 5th.

9,537. "Improvements in or relating to electro-mechanically propelled vehicles." J. Lavender. Dated May 5th.

9,555. "Improvements in or connected with electric burglar and other alarms." T. A. Clarke. Dated May 5th.

9,565. "Improvements in or connected with electric melting apparatus." M. Schindler. Dated May 5th.

9,619. "Improvements in incandescent electric lamps." S. P. Eastick and E. Sayer. Dated May 6th.

9,637. "Improvements in arc lamps." A. Blahnik. Dated May 6th.

9,650. "Improvements in electromotors and dynamos, and in apparatus for use therewith." E. Lanhoffer. Dated May 6th.

9,667. "Electric arc lamps." W. Fox. Dated May 7th.

9,668. "Electric arc lamps and projectors." W. Fox. Dated May 7th.

9,713. "A signal indicator for use on locomotives and means for electrically operating the same." D. Foulis. Dated May 7th.

9,758. "Improvements in floor cloths or carpets for the purpose of electrical distribution therein." F. Fanta. Dated May 7th.

9,759. "Improvements in or relating to motor vehicles." A. J. Boulé. (La Société Justin Landry and G. Beyroux, France.) Dated May 7th.

9,817. "Improved shade for use in connection with electric incandescent lamps and the like." E. Bach, H. S. Lewis and A. B. Saunders. Dated May 8th.

9,820. "Improvements in coupling boxes for electrical circuits." M. Binswanger and F. G. Bell. Dated May 8th.

9,832. "Improvements in telephone systems of exchange." J. E. Kingsbury. (The Western Electric Company, United States.) Dated May 8th.

9,843. "Improvements relating to electric current meters." R. P. Wilson. Dated May 8th.

9,853. "Improvements in and connected with electric belts and like appliances to be worn next the skin." E. S. Collicott. Dated May 8th.

9,910. "Improvements in secondary batteries." A. Schanschieff. Dated May 9th.

9,919. "Improvements in and relating to exhausted tubes for electrical and other purposes." W. Friese-Greene. Dated May 9th.

9,929. "The self-returning electric bell indicator." R. W. Lane. Dated May 9th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free*, 8½*d.* (*in stamps.*)]

1895.

4,065. "Improved means of working and supplying current to electric tramways and lifts." S. Z. de Ferranti. Dated February 26th, 1895. Relates to feeding the conductors with current derived from a high tension source after transformation, by means of current from a dynamo driven by an electromotor, with heavy fly-wheel and high speed, to equalise gradually the variations in the load. 7 claims.

4,478. "Improvements in electrical medical apparatus." H. C. Braun and C. R. Sharman. Dated March 2nd, 1895. The appliance consists of an oval box with a strap handle provided with metal massage rollers by means of which the current is passed to the body. The box contains a coil with armature contact breaker, &c., and an electric cell. Press buttons or other means are provided for making alterations with connections and current strength. 4 claims.

4,660. "Improvements relating to the electro-deposition of iron on copper or other metallic surfaces." A. Hiorns. Dated March 5th, 1895. The surface is first cleaned with potash, pumice and soda lime. The plate is then placed in a striking bath of a solution of ammonia-sulphate of iron and an iron plate is used for the cathode. After a thin film has been deposited by a strong current the plate is cleaned again and then placed in the plating bath, consisting of a hot solution of sulphate of iron and ammonium chloride. The coating is deposited by a weak current. 6 claims.

5,137. "Improvements in the construction and working of electrical transformers." S. Z. de Ferranti. Dated March 11th, 1895. Relates to methods for connecting and fixing transformers for convenience in working and so that the cores can easily be removed and annealed after working when requisite. 5 claims.

5,515. "Improvements in electric measuring instruments." R. E. B. Crompton. Dated March 15th, 1895. Relates to electrostatic voltmeters in which a number of fixed plates forming portions of two concentric cylinders are divided into two sets, one set being connected to one terminal the other being connected to vanes carrying a pointer, and to the other terminal the vanes moves on their common pivot in the same manner as the needle of a quadrant electrometer. 4 claims.

5,984. "Improvements in or relating to signalling and communicating by telephony and in apparatus therefor." H. J. Bentley. Dated March 22nd, 1895. Describes a system of telephonic communication between several stations whereby each can speak to all, and all to each, directly or indirectly, and in which the signalling circuit is automatically completed by signalling circuits, and preferably partly by the initial signal and completely by the reply signal. Certain details are also claimed. 5 claims.

6,035. "Improvements in electric conductors." J. A. Rossiter. Dated March 23rd, 1895. The inventor claims to effect improvements in electric conductors by utilising the principle of condensation of electricity as exemplified by the Leyden jar. 3 claims.

8,081. "Improvements in the active material for secondary and primary batteries." A. Schanschieff. Dated April 23rd, 1895. Claims an active material paste made by carbonising sugar or the like with sulphuric acid, cooling mixture with an oxide or salt and working into a dough with sulphuric acid. 1 claim.

8,167. "Improvements in electrically heated ironing and similar appliances." A. Labbe and A. Coussinet. Dated April 25th, 1895. Claims the combination of hollow irons with a mechanism of bars of carbon described for the purpose stated. 8 claims.

8,222. "Improvements in telephonic systems and apparatus." J. E. Kingsbury. (A communication from the Western Electric Company, Chicago, U.S.A.) Dated April 25th, 1895. Relates to apparatus by means of which signals are sent from the subscriber's station to the central station through the agency of a common battery, and also to arrangements whereby telephonic transmitters at subscribers' stations are energised and various automatic visual signals and clearing out drops are operated at the central station. These two features of the invention can be used separately or together. 6 claims.